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General Description

Freightliner front suspensions use either a taperleaf or a flatleaf assembly. The taperleaf suspensions are available in varying capacities from 6,000-pound (2 722 kg) to 14,000-pound (6 350 kg). Shock absorbers are standard. The flatleaf suspensions are available in varying capacities from 12,000-pound (5 543 kg) to 18,000-pound (8 165 kg), and shock absorbers are optional.

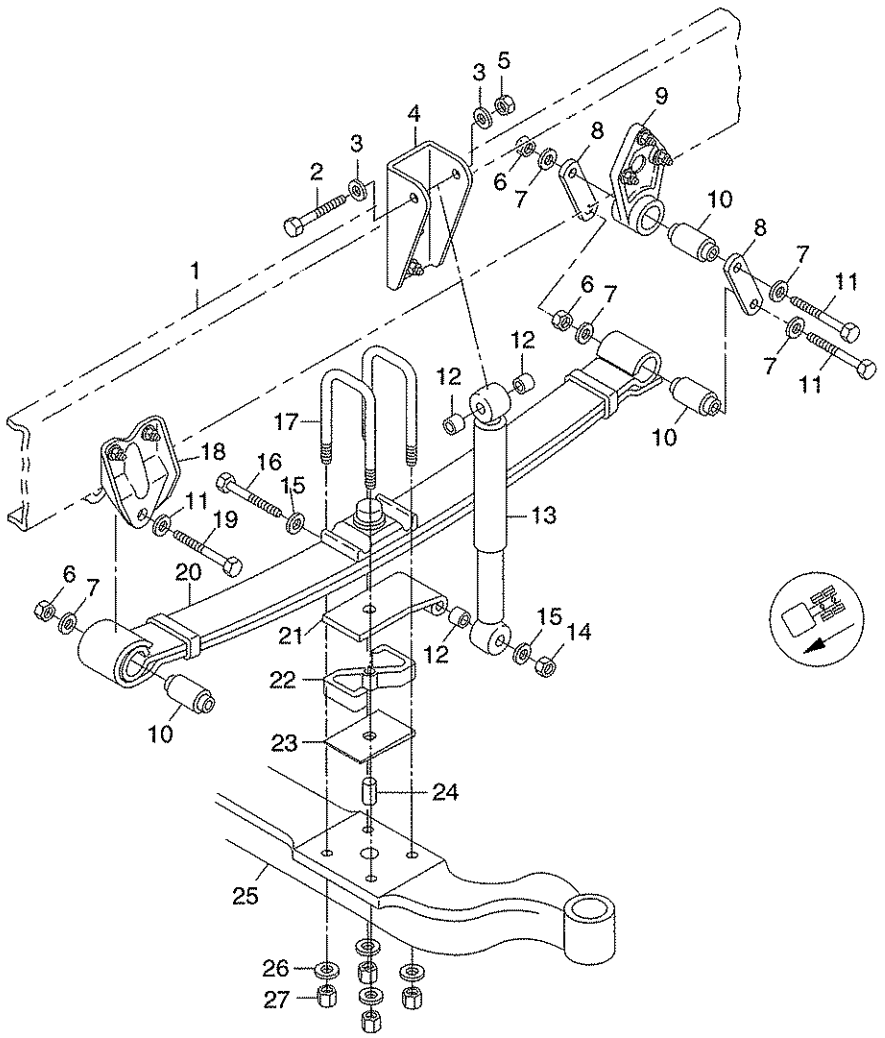
The spring assemblies are attached to the axle with U-bolts, hardened washers, and high nuts. See **Fig. 1**, **Fig. 2**, **Fig. 3**, and **Fig. 4**. The forward end of each spring mounts to a stationary front spring bracket. The rear of each spring mounts to a spring shackle suspended from a frame-mounted bracket. The shackle allows for variations in spring length as the spring flexes.

The leaf spring assembly absorbs and stores energy over bumps, releasing it at a controlled rate to smooth the ride. Individual spring leaves are held together by a center bolt. Alignment clips limit the sideways spread and vertical separation of the individual leaves.

A design change implemented in March 1999 combines the axle pad and the shock absorber lower mounting bracket into one part. See **Fig. 5**.

The all-wheel-drive front suspension (see **Fig. 6**) is nearly identical to the standard front suspension, except the U-bolts are longer and there is a thicker steel spacer between the leaf springs and the top of the front axle. See **Subject 130** for information about the all-wheel-drive front suspension.

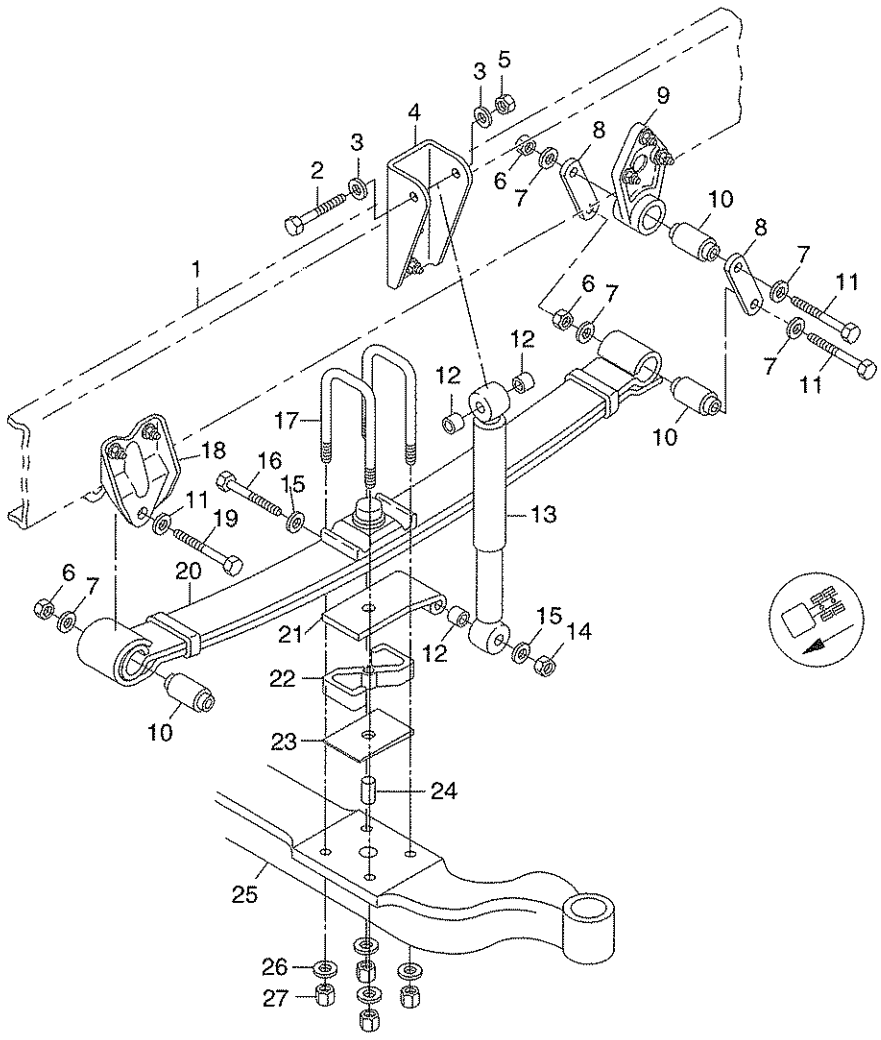
General Information



03/25/96 f320253a

1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 3/4–10, Grade C
7. Hardened Washer
8. Spring Shackle
9. Shackle Bracket
10. Bushing
11. Spring Shackle Bolt, 3/4–10 x 6.5
12. Spacer
13. Shock Absorber
14. Hexnut
15. Hardened Washer
16. Shock Absorber Lower Mounting Bolt
17. U-Bolt, 5/8–18
18. Front Spring Bracket
19. Front Spring Mounting Eye Bolt, 3/4–10 x 6
20. Spring Assembly
21. Shock Absorber Lower Mounting Bracket
22. Spacer
23. Caster Adjustment Shim
24. Dowel Pin
25. Axle
26. Hardened Washer
27. High Hexnut, 5/8–18

Fig. 1, 6,000-Pound Taperleaf Front Suspension

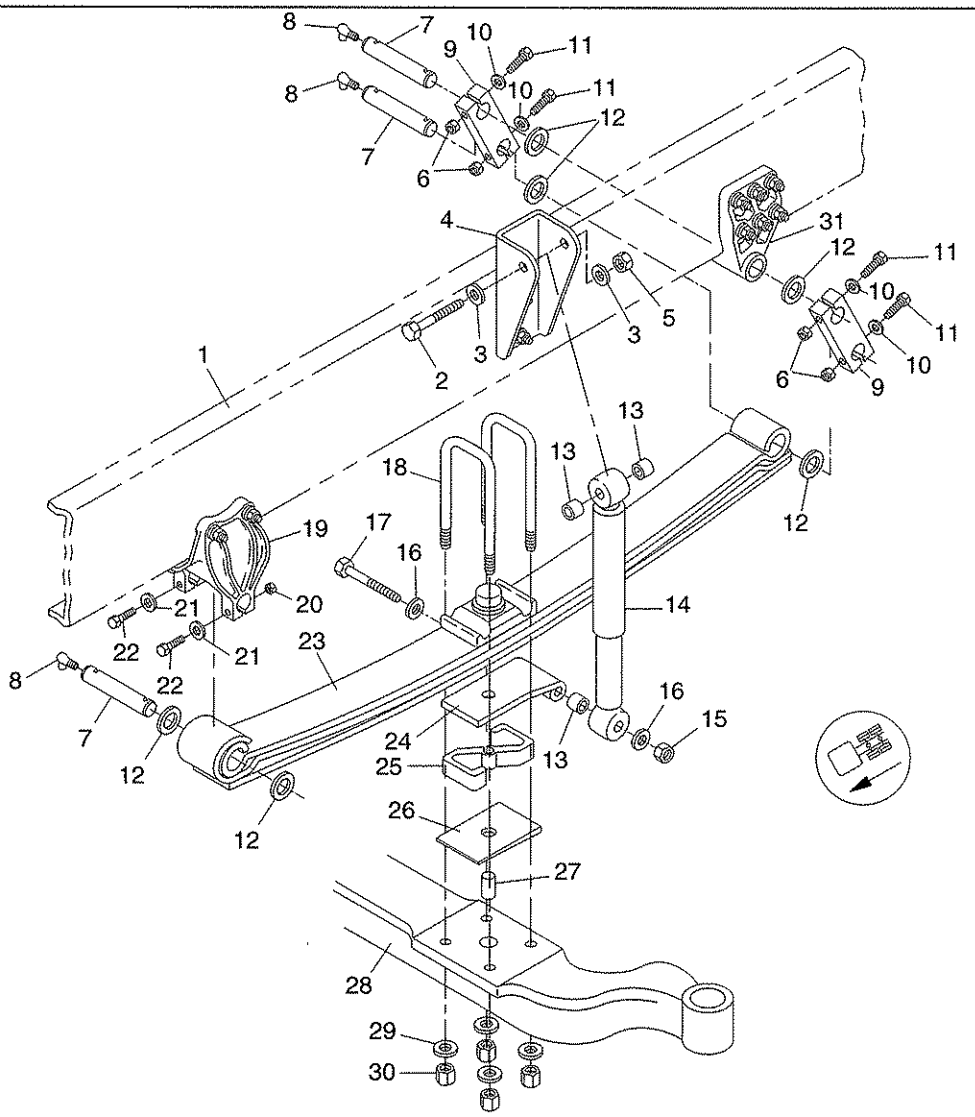


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1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 3/4–10, Grade C
7. Hardened Washer
8. Spring Shackle
9. Shackle Bracket
10. Bushing
11. Spring Shackle Bolt, 3/4–10 x 6.5
12. Spacer
13. Shock Absorber
14. Hexnut
15. Hardened Washer
16. Shock Absorber Lower Mounting Bolt
17. U-Bolt, 3/4–16
18. Front Spring Bracket
19. Front Spring Mounting Eye Bolt, 3/4–10 x 6
20. Spring Assembly
21. Shock Absorber Lower Mounting Bracket
22. Spacer
23. Caster Adjustment Shim
24. Dowel Pin
25. Axle
26. Hardened Washer
27. High Hexnut, 3/4–16, Grade C

Fig. 2, 12,000-Pound Taperleaf Front Suspension

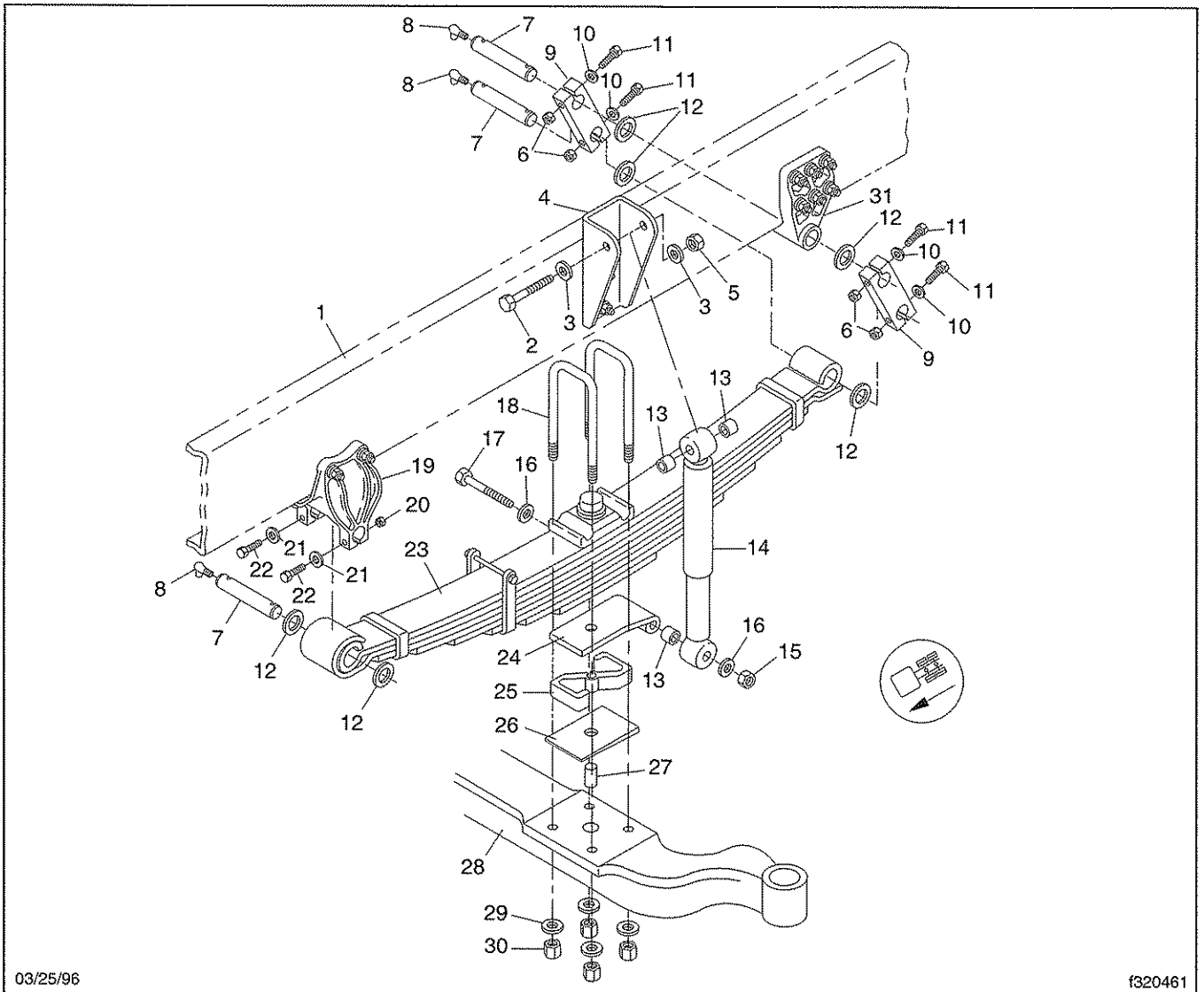
General Information



03/25/96 f320460

1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 1/2–13
7. Spring Pin
8. Zerk Fitting
9. Shackle Bracket
10. Bearing Washer
11. Spring Shackle Bolt, 1/2–13 x 3.25
12. Spring Shim Washer
13. Spacer
14. Shock Absorber
15. Hexnut
16. Hardened Washer
17. Shock Absorber Lower Mounting Bolt
18. U-bolt, 7/8–14
19. Front Spring Bracket
20. Hexnut, 1/2–13
21. Bearing Washer
22. Front Spring Bracket Bolt, 1/2–13 x 3.25
23. Spring Assembly
24. Shock Absorber Lower Mounting Bracket
25. Spacer
26. Caster Adjustment Shim
27. Dowel Pin
28. Axle
29. Hardened Washer
30. High Hexnut, 7/8–14, Class C
31. Rear Shackle Bracket

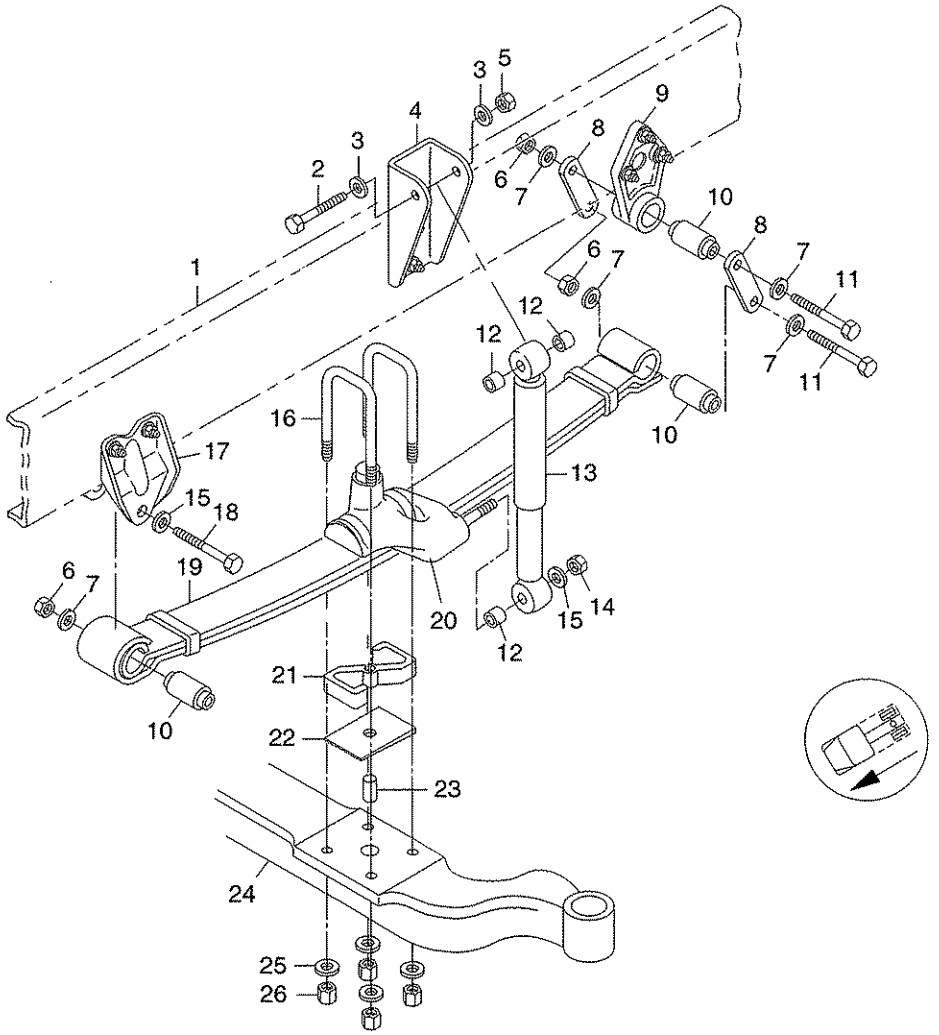
Fig. 3, 14,000-Pound (6 350 kg) Taperleaf Suspension



1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 1/2–13, Class C
7. Spring Pin
8. Zerk Fitting
9. Spring Shackle
10. Bearing Washer
11. Spring Shackle Bolt, 1/2–13 x 3.25
12. Spring Shim Washer
13. Spacer
14. Shock Absorber
15. Hexnut
16. Hardened Washer
17. Shock Absorber Lower Mounting Bolt
18. U-bolt, 7/8–14
19. Front Spring Bracket
20. Hexnut, 1/2–13
21. Bearing Washer
22. Front Spring Bracket Bolt, 1/2–13 x 3.25
23. Spring Assembly
24. Shock Absorber Lower Mounting Bracket
25. Spacer
26. Caster Adjustment Shim
27. Dowel Pin
28. Axle
29. Hardened Washer
30. High Hexnut, 7/8–14, Class C
31. Rear Shackle Bracket

Fig. 4, Flatleaf Front Suspension

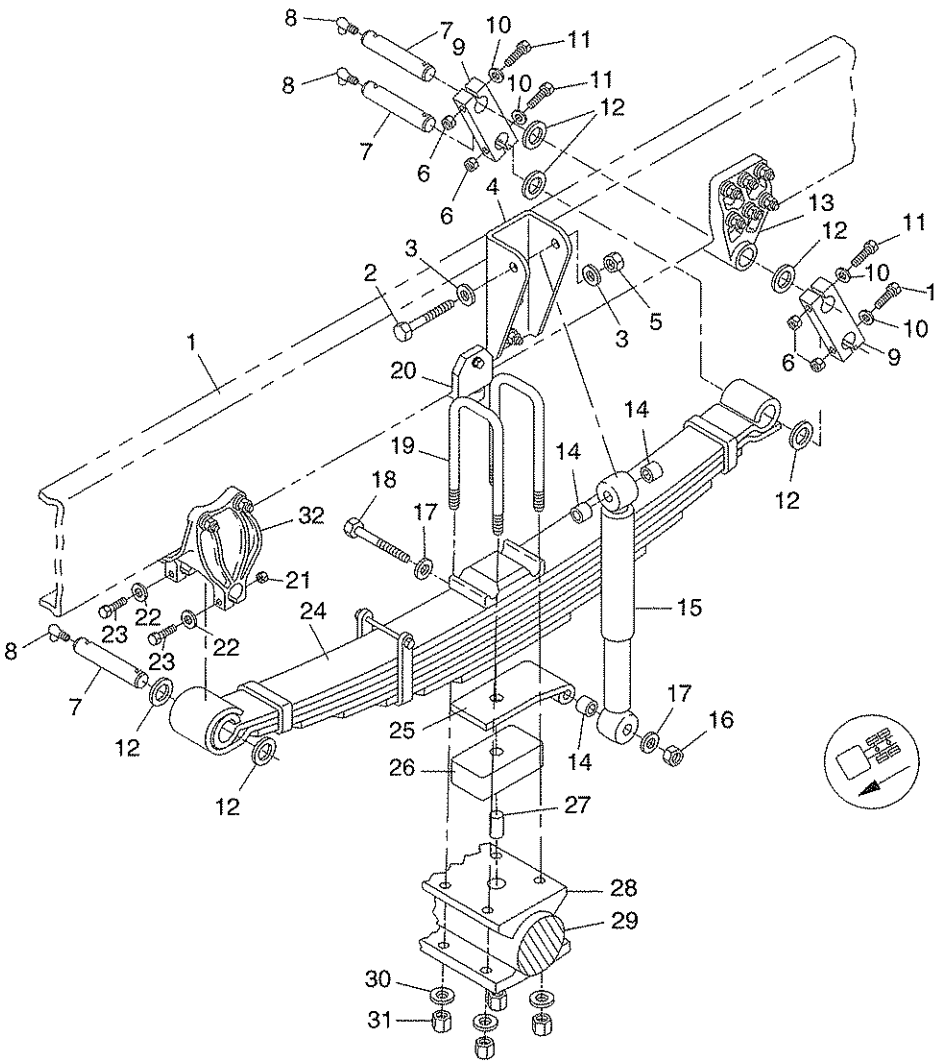
General Information



11/09/2001 f320839

1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 3/4–10, Grade C
7. Hardened Washer
8. Spring Shackle
9. Shackle Bracket
10. Bushing
11. Spring Shackle Bolt, 3/4–10 x 6.5
12. Spacer
13. Shock Absorber
14. Hexnut
15. Hardened Washer
16. U-Bolt
17. Front Spring Bracket
18. Front Spring Eye Mounting Bolt
19. Spring Assembly
20. Shock Absorber Lower Mounting Bracket
21. Spacer
22. Caster Adjustment Shim
23. Dowel Pin
24. Axle
25. Hardened Washer
26. High Hexnut

Fig. 5, Axle Stop and Shock Absorber Lower Mounting Bracket After March 1999 (12,000-pound taperleaf shown)



03/25/96 f320516

1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 1/2–13, Class C
7. Spring Pin
8. Zerk Fitting
9. Spring Shackle
10. Bearing Washer
11. Spring Shackle Bolt, 1/2–13 x 3.5
12. Spring Shim Washer
13. Rear Shackle Bracket
14. Spacer
15. Shock Absorber
16. Hexnut
17. Hardened Washer
18. Shock Absorber Lower Mounting Bolt
19. U-Bolt, 7/8–14
20. Axle Stop
21. Hexnut, 1/2–13, Class C
22. Bearing Washer
23. Front Spring Bracket Bolt, 1/2–13 x 3.5
24. Spring Assembly
25. Shock Absorber Lower Mounting Bracket
26. Spacer
27. Dowel Pin
28. Axle Mounting Bracket
29. Axle
30. Hardened Washer
31. High Hexnut, 7/8–14
32. Front Spring Bracket

Fig. 6, All-Wheel-Drive Front Suspension (exploded view)

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation

Removal

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the rear tires.
2. Open the hood.
3. Remove the front bumper. For instructions, see **Group 31**.
4. Remove the wheel and tire for access to the leaf spring. For instructions, see **Group 40**.
5. Remove the half-fender. For instructions, see **Group 88**.

⚠ WARNING

Use safety stands to securely support all axle and frame weight during suspension repairs. Unsecured components may drop when fasteners are loosened or removed, causing component damage and serious personal injury.

IMPORTANT: Make sure the frame rails are level and an equal distance off the ground.

6. Raise the front of the vehicle until both wheels are off the ground and the frame and axle are supported with safety stands. The axle and leaf springs can then be manipulated with the floor jack.
7. Remove the leaf spring assembly.

   NOTE: Leaf spring assemblies on vehicles with suspensions manufactured at 14,000-pound (6 350 kg) and 18,000-pound (8 165 kg) weight ratings have multiple leaf springs, heavy duty brackets, U-bolts, and other components.

   7.1 Remove the U-bolt high nuts and washers. Remove the U-bolts. See **Fig. 1**.

   7.2 Loosen the shock absorber upper mounting bolt. Swing the shock absorber and attached lower mounting bracket out of the way. See **Fig. 2** or **Fig. 3**.

   7.3 Remove the spring shackle lower bolt. See **Fig. 4**.

   7.4 Remove the front spring mounting eye bolt. See **Fig. 5**.

   NOTE: If removing the driver's side spring, the steering must be at right full-lock so the bolt can clear the drag link.

   7.5 Support the front axle with a jack. Remove the safety stand and lower the front axle enough to allow removal of the spring. Note the location of the spring spacer and any caster adjustment shims.

⚠ WARNING

The spring assembly is heavy. To prevent bodily injury, always use two people to remove it.

   7.6 Remove the spring by sliding it toward the front of the vehicle. See **Fig. 6**.

8. Remove the shackle upper bolt and nut. See **Fig. 7**. Press out the bushing. Remove the fasteners that hold the shackle bracket to the frame and remove the bracket. See **Fig. 8**.

Cleaning and Inspection

1. Using a wire brush and solvent or steam cleaning equipment, wash all parts to remove dirt, grease, and scale.
2. Inspect all components for damage.

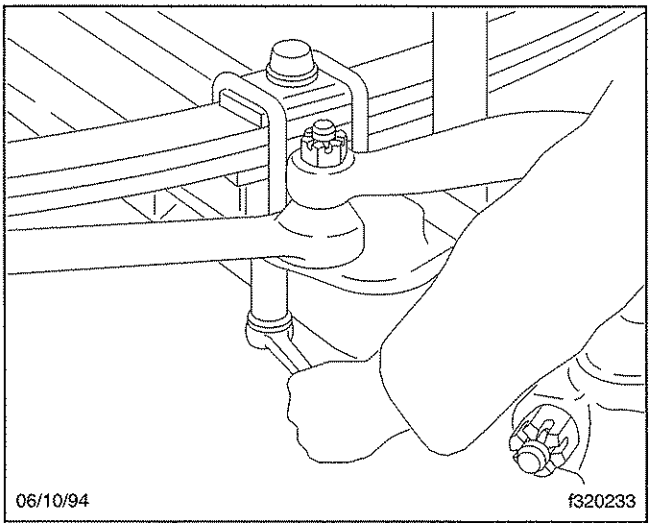
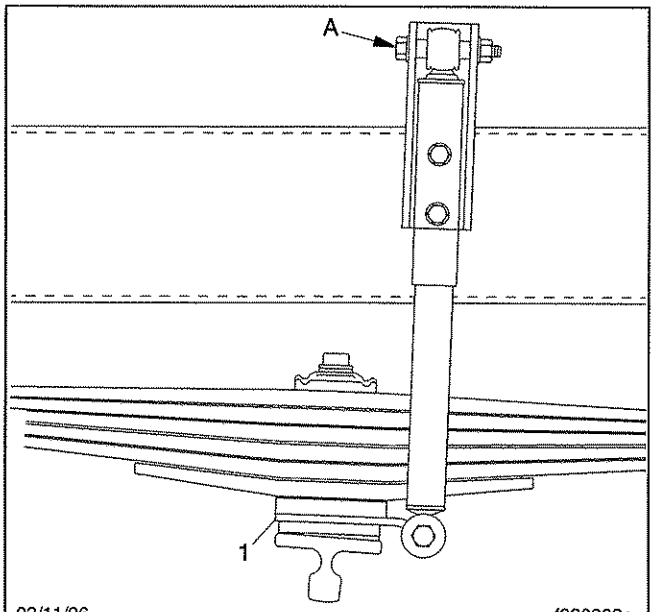


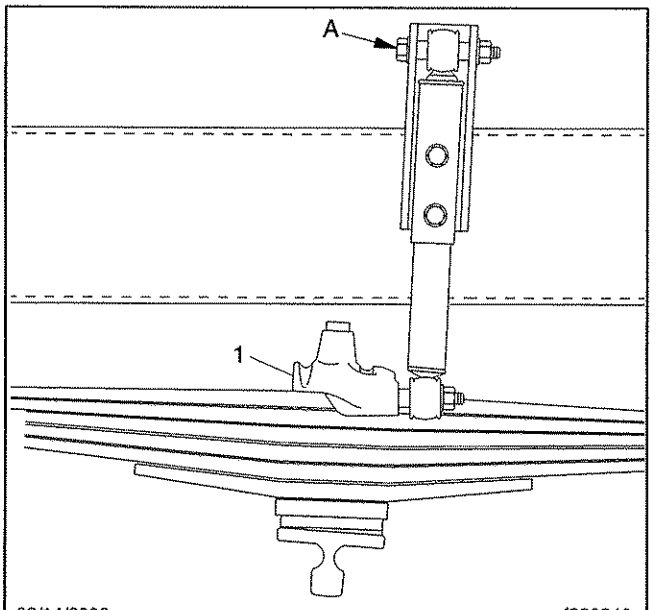
Fig. 1, U-Bolt Removal

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation



A. Loosen the shock absorber upper mounting bolt.
1. Shock Absorber Lower Mounting Bracket

Fig. 2, Shock Absorber Lower Mounting Bracket Before March 1999



A. Loosen the shock absorber upper mounting bolt.
1. Shock Absorber Lower Mounting Bracket

Fig. 3, Shock Absorber Lower Mounting Bracket After March 1999

2.1 Inspect the spring shackles and the shackle bracket for cracks, wear, and other damage. Replace any damaged parts.

2.2 Inspect the leaf spring assembly for cracks or corrosion. If any leaves are cracked or broken, replace the *entire spring assembly.*

⚠ WARNING

Do not replace individual leaves of a leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

2.3 If the protective coating is gone from some areas of the spring, the cleaned areas can be painted with a rust-inhibiting paint. If rusting or corrosion is severe, replace the spring assembly.

Installation

IMPORTANT: For normal highway operation do not install springs of two different designs or load capacities on the front axle. In order to maintain a balanced front suspension system, install identical spring assemblies.

1. If the shackle bracket was removed, install it. See **Fig. 8**. Tighten the mounting bolts 135 lbf·ft (183 N·m).

NOTE: All suspension bracket (frame) fasteners require periodic retightening. See **Group 00** of the *Business Class® Trucks Maintenance Manual* for the recommended intervals.

2. If the spring shackle was removed, install it. Do not tighten the upper bolt in the shackle at this time. See **Fig. 7**.

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation

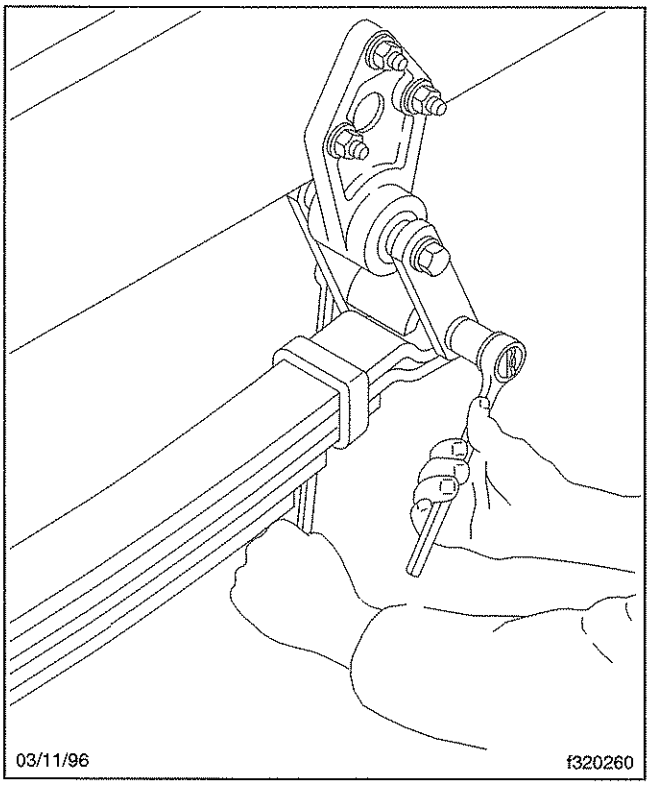


Fig. 4, Spring Shackle Lower Bolt Removal/ Installation

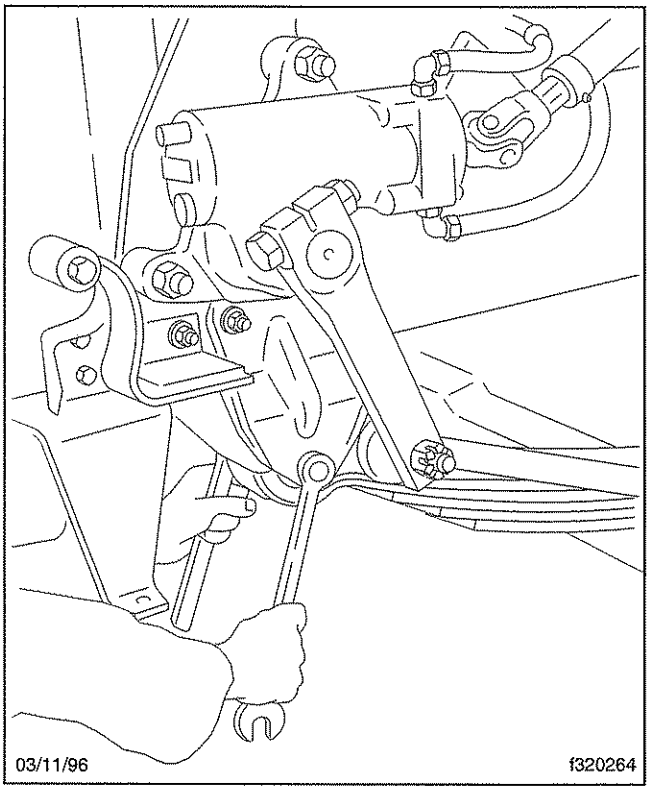


Fig. 5, Spring Eye Bolt Removal/Installation

⚠ WARNING

The spring assembly is heavy. To prevent bodily injury, always use two people to install it.

3. Install the spring assembly.

   NOTE: Leaf spring assemblies on vehicles with suspensions manufactured at 14,000-pound (6 350 kg) and 18,000-pound (8 165 kg) weight ratings have multiple leaf springs, heavy duty brackets, U-bolts, and other components.

   3.1 Lift the spring into position. See **Fig. 6**. Install the spring eye bolt at the front of the spring (see **Fig. 5**) and the lower bolt in the shackle at the rear of the spring (see **Fig. 4**).

   3.2 Tighten the spring eye bolt and the bolts at the top and bottom of the shackle 240 lbf·ft (325 N·m).

   3.3 Apply Alumilastic® or a similar compound to the top and bottom of the spring spacer and any caster adjustment shims.

⚠ CAUTION

Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel parts contact each other, could lead to corrosion of the metals, resulting in damage to suspension parts.

   3.4 Place the caster adjustment shim and spring spacer on the axle. See **Fig. 9** or **Fig. 10**.

   3.5 Place the U-bolt pad (and shock absorber lower mounting bracket, if equipped, for vehicles built after March 1999) in position on the leaf spring.

   3.6 Using a jack, lift the axle into position.

   3.7 For vehicles so equipped (and built before March 1999), position the shock absorber

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation

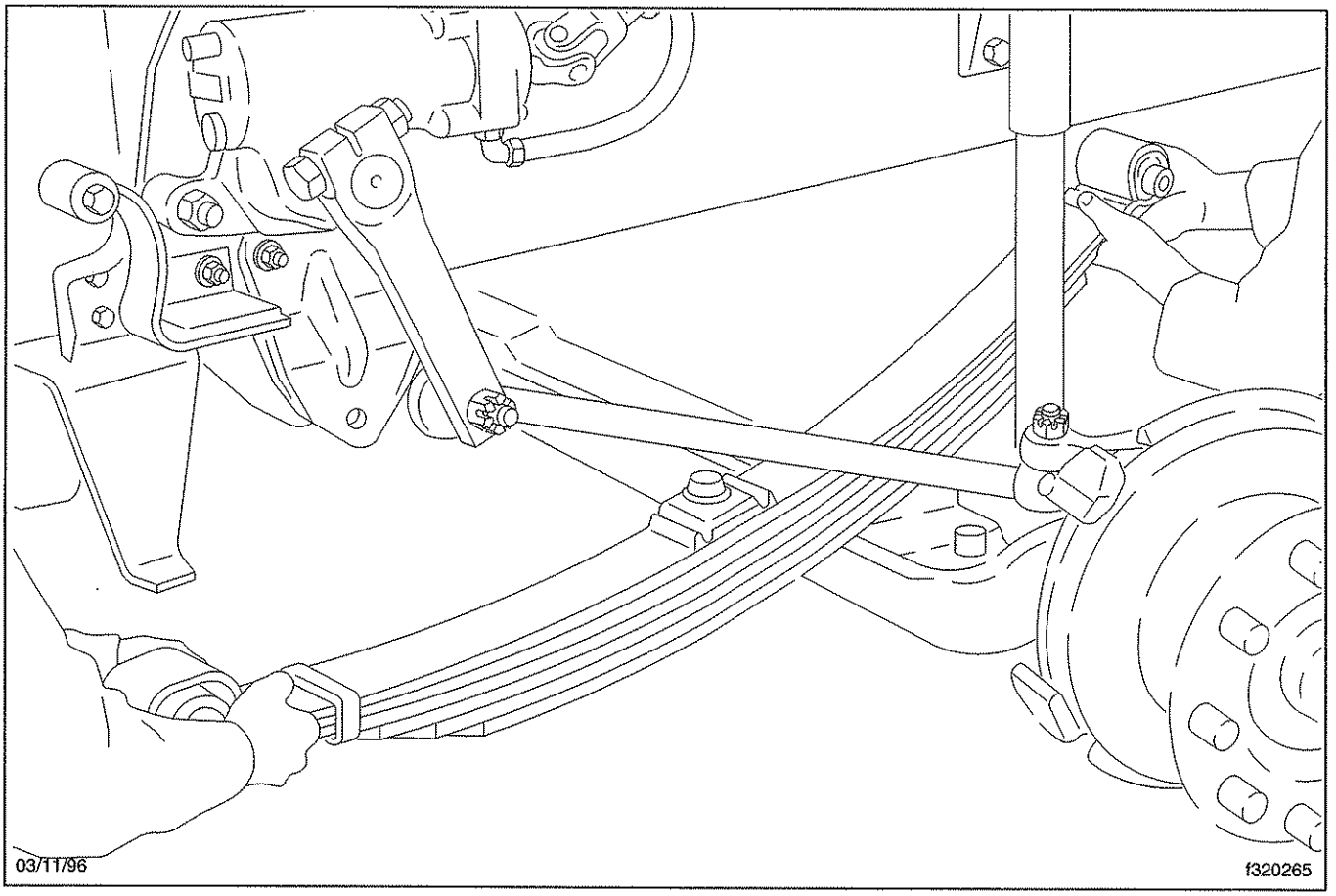


Fig. 6, Spring Removal/Installation

lower mounting bracket between the spring spacer and the caster adjustment shims.

3.8 Install the U-bolts over the spring leaves, spring spacer, shock absorber lower mounting bracket, caster adjustment shims, and through the front axle.

3.9 Install the high nuts on the U-bolts and tighten them as described in **Specifications 400**.

4. Remove the floor jack and safety stands.
5. Install the half-fender. See **Group 88** for instructions.
6. Install the wheel and tire. See **Group 40** for instructions.
7. Install the front bumper. For instructions, see **Group 31**.
8. Close and latch the hood.
9. Remove the chocks from the tires.

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation

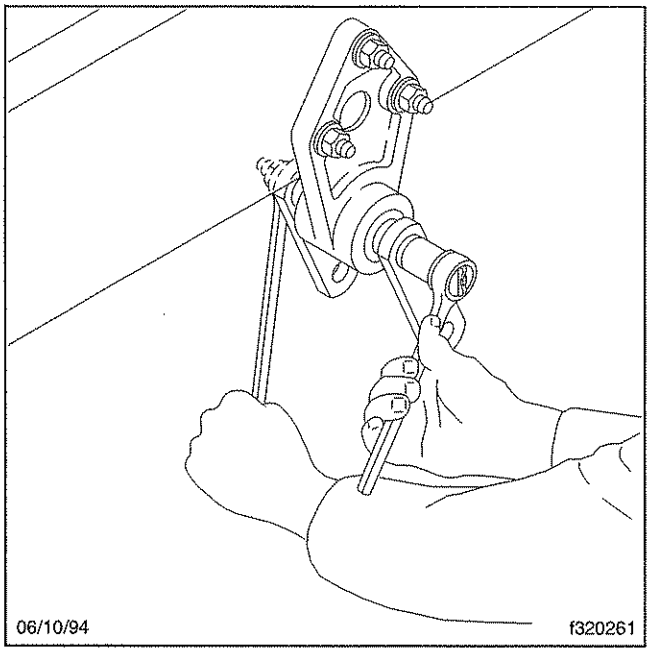


Fig. 7, Spring Shackle Removal/Installation

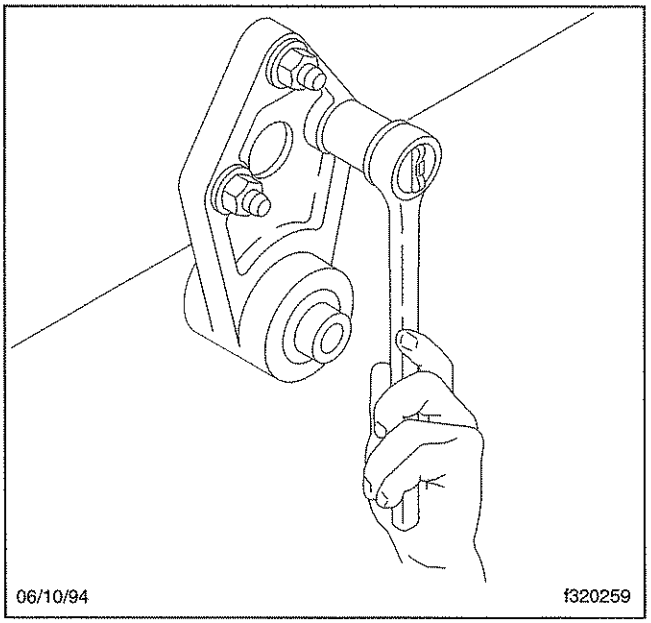
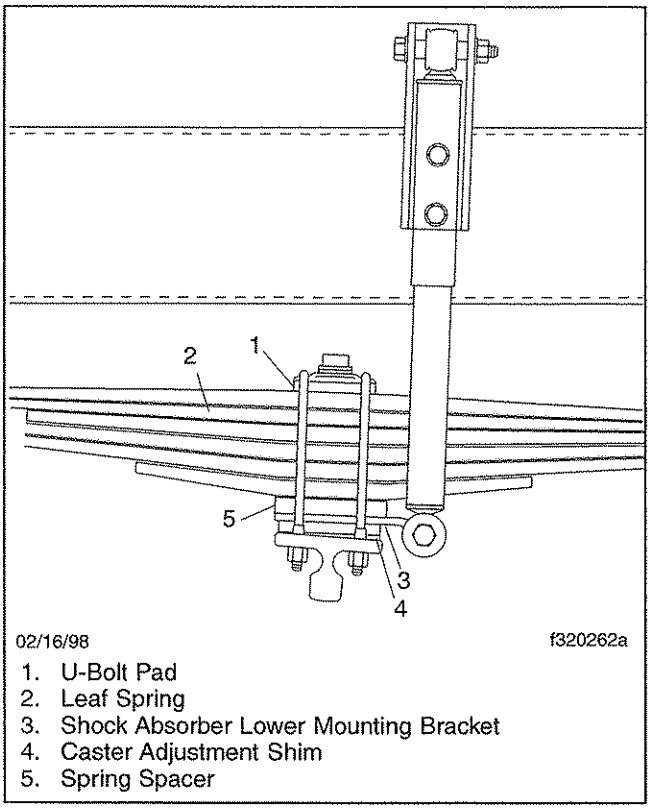


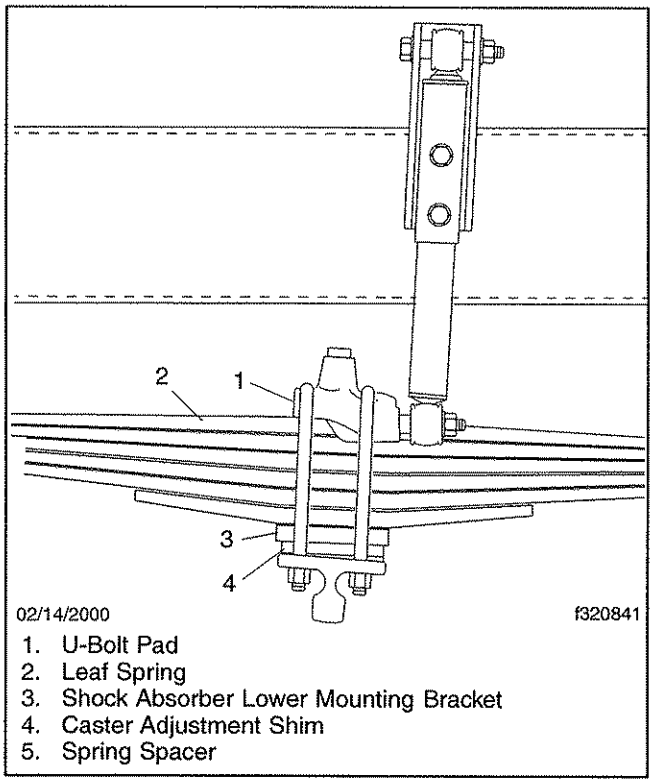
Fig. 8, Shackle Bracket Removal/Installation



1. U-Bolt Pad
2. Leaf Spring
3. Shock Absorber Lower Mounting Bracket
4. Caster Adjustment Shim
5. Spring Spacer

Fig. 9, Caster Adjustment Shim Location Before March 1999

Leaf Spring and Components Removal, Cleaning and Inspection, and Installation



1. U-Bolt Pad
2. Leaf Spring
3. Shock Absorber Lower Mounting Bracket
4. Caster Adjustment Shim
5. Spring Spacer

Fig. 10, Caster Adjustment Shim Location After March 1999

Shackle Bracket Bushing Replacement

1. Park the vehicle on a level surface and apply the parking brakes. Shut down the engine. Chock the rear tires.
2. Open the hood.
3. Remove the front bumper. For instructions, see **Group 31**.
4. Remove the wheel and tire for access to the leaf spring. For instructions, see **Group 40**.
5. Remove the half-fender. For instructions, see **Group 88**.
6. Remove the shackle bracket from the vehicle. See **Fig. 1** or **Fig. 2**.
   - 6.1 Jack up the frame until the shackle lower bolt can be removed. Remove the bolt.
   - 6.2 Remove the shackle upper bolt and the spring shackle.
   - 6.3 Remove the shackle bracket from the frame.
7. Using a press, remove the bushing from the shackle bracket.
8. Inspect the shackle bracket and new bushing.
   - 8.1 With an inside micrometer or bore gauge, check whether the bracket bore is out-of-round. Replace the bracket if the bushing bore is out-of-round.
   - 8.2 Before installing the new bushing, check the shackle bracket bolt for ease of fit in the bushing. There should be an easy slip fit without wobble between the bolt and the bushing.
9. Using a press, insert the new bushing into the bracket until the bushing is centered in the bracket.

IMPORTANT: Do not press in the bushing by the center sleeve. This could damage the bushing.

10. Check the shackle bracket bolt again for ease of fit in the bushing. It should still fit easily without wobble between the bolt and the bushing. If it binds, the bushing may have been distorted during installation. Replace the bushing and check again for proper fit.
11. Install the shackle bracket. Install the fasteners and tighten them 183 N·m (135 lbf·ft).
12. Connect the leaf spring.
    - 12.1 Install the spring shackle and the shackle upper bolt.
    - 12.2 Adjust the height of the jack supporting the frame until the bushing at the rear of the leaf spring lines up with the hole for the shackle lower bolt.
    - 12.3 Install the shackle lower bolt. Tighten it 325 N·m (240 lbf·ft).
13. Install the half-fender. For instructions, see **Group 88**.
14. Install the wheel and tire. For instructions, see **Group 40**.
15. Install the front bumper. For instructions, see **Group 31**.
16. Close and latch the hood.
17. Remove the chocks from the tires.

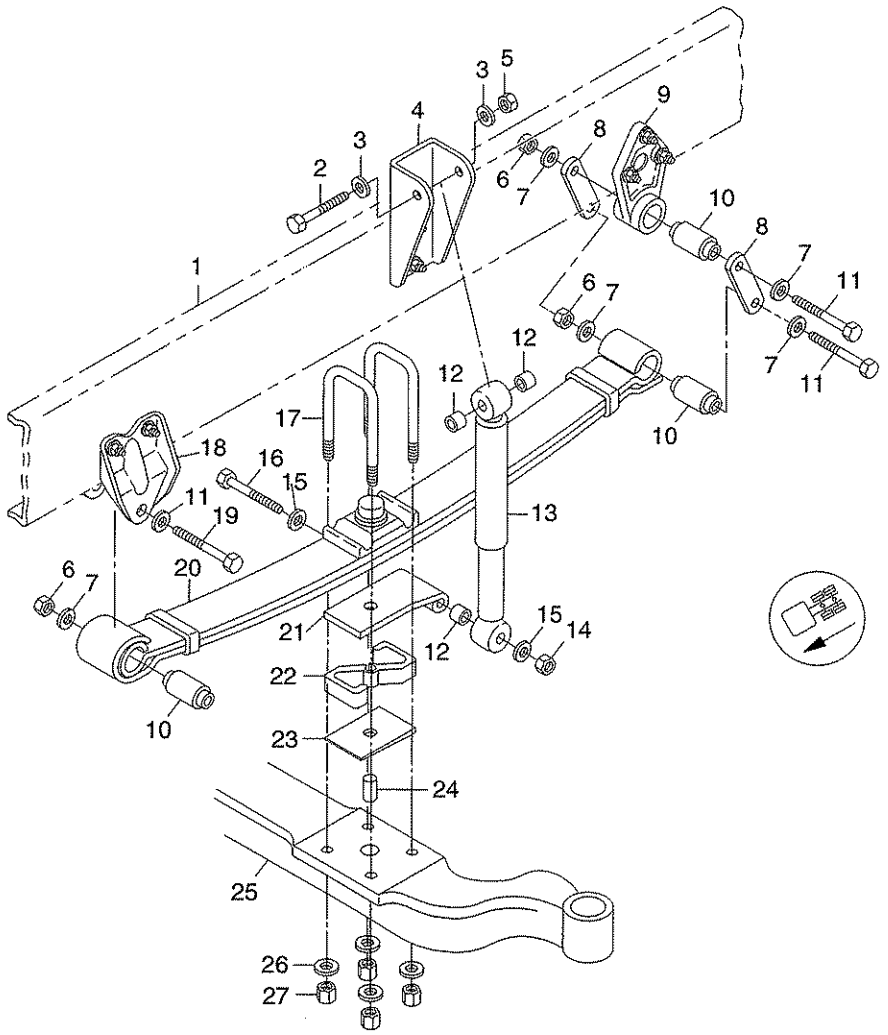
Spring Bushing Replacement

1. Remove the leaf spring from the vehicle. For instructions, see **Subject 100**.
2. Using a press, remove the worn or damaged bushing.
3. Using a press, insert the new bushing into the spring eye until the bushing is flush with the edges of the spring eye.

IMPORTANT: Do not press in the bushing by the center sleeve. This could damage the bushing.

4. Install the leaf spring. For instructions, see **Subject 100**.

Bushing Replacement

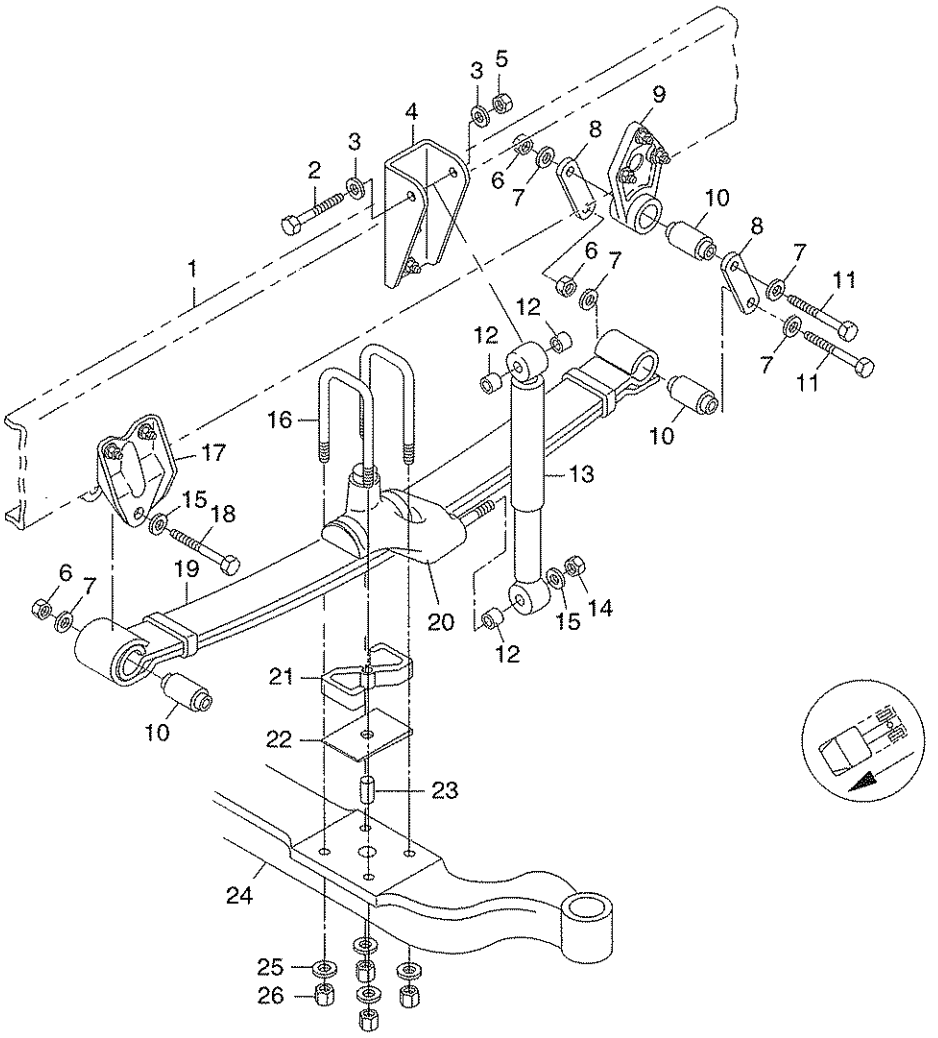


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1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 3/4–10, Grade C
7. Hardened Washer
8. Spring Shackle
9. Shackle Bracket
10. Bushing
11. Spring Shackle Bolt, 3/4–10 x 6.5
12. Spacer
13. Shock Absorber
14. Hexnut
15. Hardened Washer
16. Shock Absorber Lower Mounting Bolt
17. U-Bolt, 5/8–18
18. Front Spring Bracket
19. Front Spring Mounting Eye Bolt, 3/4–10 x 6
20. Spring Assembly
21. Shock Absorber Lower Mounting Bracket
22. Spacer
23. Caster Adjustment Shim
24. Dowel Pin
25. Axle
26. Hardened Washer
27. High Hexnut, 5/8–18

Fig. 1, Front Suspension Before March 1999

Bushing Replacement



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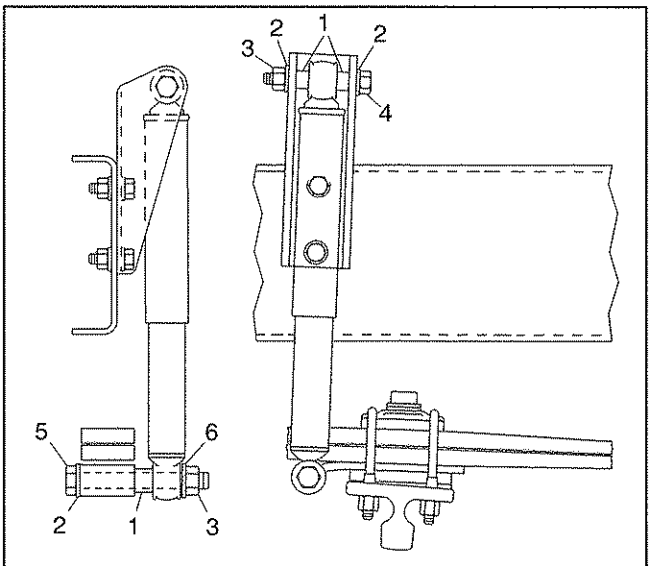
1. Frame Rail
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14. Hexnut
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16. U-Bolt
17. Front Spring Bracket
18. Front Spring Eye Mounting Bolt
19. Spring Assembly
20. Shock Absorber Lower Mounting Bracket
21. Spacer
22. Caster Adjustment Shim
23. Dowel Pin
24. Axle
25. Hardened Washer
26. High Hexnut

Fig. 2, Front Suspension After March 1999

Shock Absorber Replacement

Replacement

1. Park the vehicle on a level surface and apply the parking brake. Shut down the engine. Chock the rear tires.
2. Open the hood.
3. Remove the shock absorber.
   - 3.1 Remove the locknut from the shock absorber upper mount. Remove the capscrew, washers, and spacers.
   - 3.2 Remove the locknut from the shock absorber lower mount. Remove the capscrew, washers, and spacers.
   - 3.3 Remove the shock absorber.
4. Install the new shock absorber. Make sure the washer is on the lower shock absorber mounting bushing and toward the outside. Tighten the locknuts 149 N·m (110 lbf·ft). See **Fig. 1** or **Fig. 2**.
5. Close and latch the hood.
6. Remove the chocks from the tires.

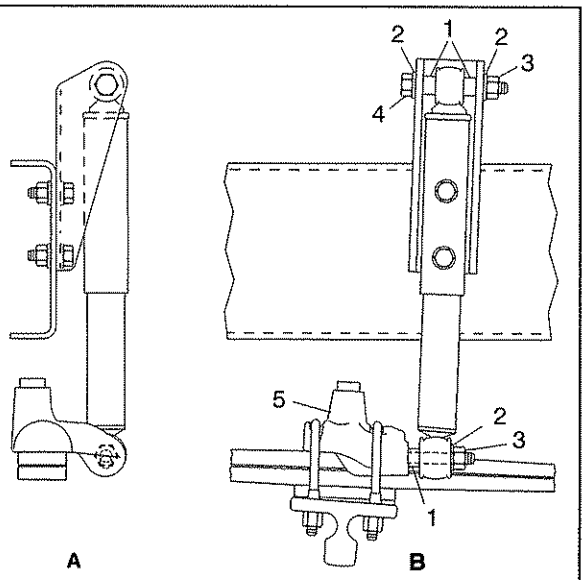


A. Front View
1. Spacer
2. 3/4-Inch Washer
3. 3/4-Inch Locknut

B. Side View
4. 3/4–10 x 5.5 Capscrew
5. 3/4–10 x 7 Capscrew
6. Washer

Fig. 1, Shock Absorber Mounting Before March 1999

Shock Absorber Replacement



A. Front View
B. Side View

1. Spacer
2. 3/4-Inch Washer
3. 3/4-Inch Locknut
4. 3/4–10 x 5.5 Capscrew
5. Lower Shock Absorber Mounting Bracket

Fig. 2, Shock Absorber Mounting After March 1999

All-Wheel-Drive Components Removal, Cleaning and Inspection, and Installation

Removal

1. Apply the parking brakes, chock the rear tires, and tilt the hood.
2. Remove the front bumper. Remove the wheel and tire for access to the leaf spring. For instructions, see **Group 40**.
3. Remove the half-fender. For instructions, see **Group 88**.
4. Using a floor jack, lift the front of the vehicle by the frame until all weight is off the spring being removed.
5. Support the frame and axle with safety stands.

⚠ WARNING

Use safety stands to securely support all axle and frame weight during suspension repairs. Unsecured components may drop when fasteners are loosened or removed, causing serious personal injury and component damage.

6. Remove the leaf spring assembly.
   - 6.1 Remove the U-bolt high nuts and washers; then, remove the U-bolts. See **Fig. 1**.
   - 6.2 Loosen the shock absorber upper mounting bolt. Swing the shock absorber and attached lower mounting bracket out of the way. See **Fig. 2**.
   - 6.3 Remove the lower spring shackle bolt.

   NOTE: All-wheel-drive suspensions use either spring pins or bolts in the leaf spring assembly to attach the leaf spring to the shackle and front spring bracket.

   - 6.4 Remove the spring front eye bolt or spring pin. See **Fig. 3**.

   NOTE: If removing the driver's side spring, the steering must be at right full-lock so the bolt or spring pin can clear the drag link.

   - 6.5 Support the front axle with a jack. Remove the safety stand; then, lower the front axle enough to allow removal of the spring. Note the location of the spring spacer.
   - 6.6 Remove the spring by sliding it toward the front of the vehicle. See **Fig. 4**.
7. Remove the upper shackle. If necessary, press out the spring pin. Remove the fasteners that hold the shackle bracket to the frame. Then, remove the bracket.

Cleaning and Inspection

1. Using a wire brush and solvent or steam cleaning equipment, wash all parts to remove dirt, grease, and scale.
2. Inspect all components for damage.
   - 2.1 Inspect the spring shackles and the shackle bracket for cracks, wear, and other damage. Replace any damaged parts.
   - 2.2 Inspect the leaf spring assembly for cracks or corrosion. If any leaves are cracked or broken, replace the *entire spring assembly.*

⚠ WARNING

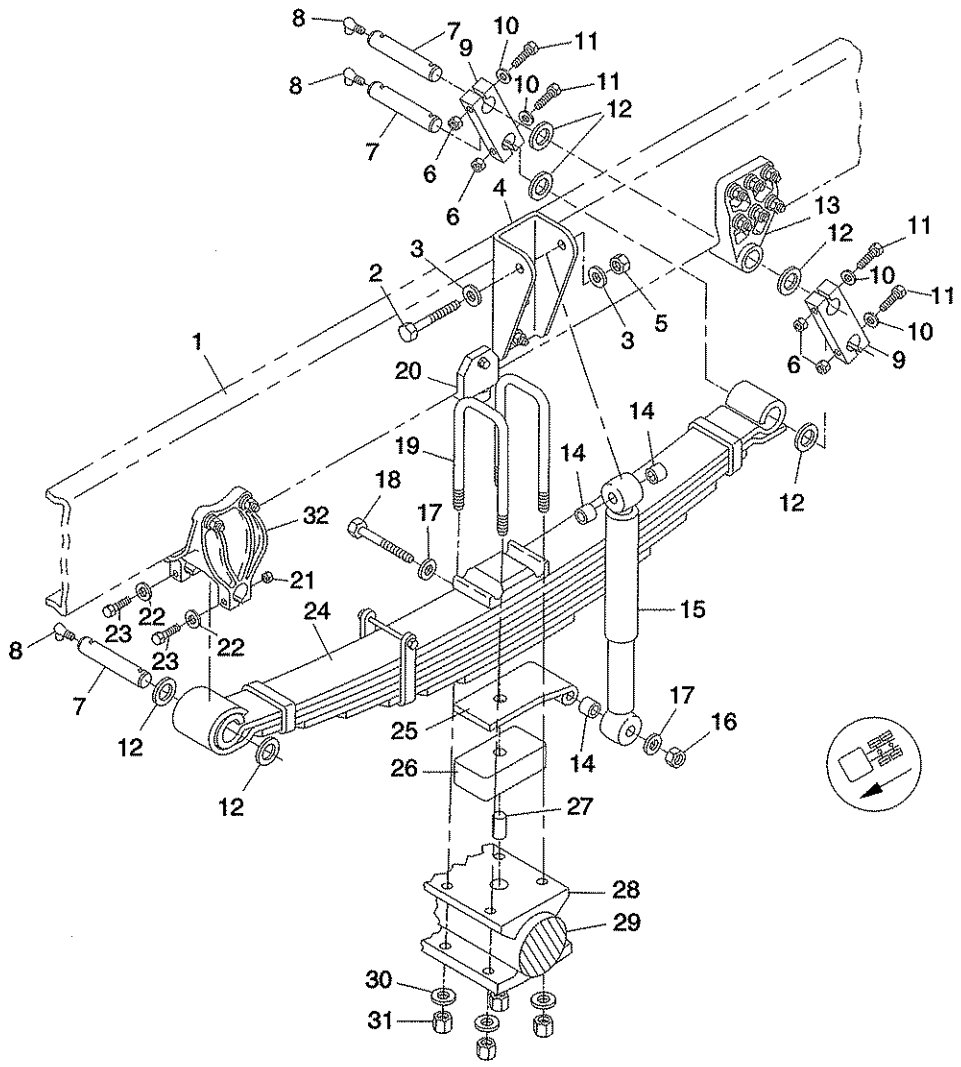
Do not replace individual leaves of a leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

   - 2.3 If the protective coating is gone from some areas of the spring, the cleaned areas can be painted with a rust-inhibiting paint. If rusting or corrosion is severe, replace the spring assembly.

Installation

IMPORTANT: For normal highway operation do not install springs of two different designs or load capacities on the front axle. In order to maintain a balanced front suspension system, install identical spring assemblies.

All-Wheel-Drive Components Removal, Cleaning and Inspection, and Installation

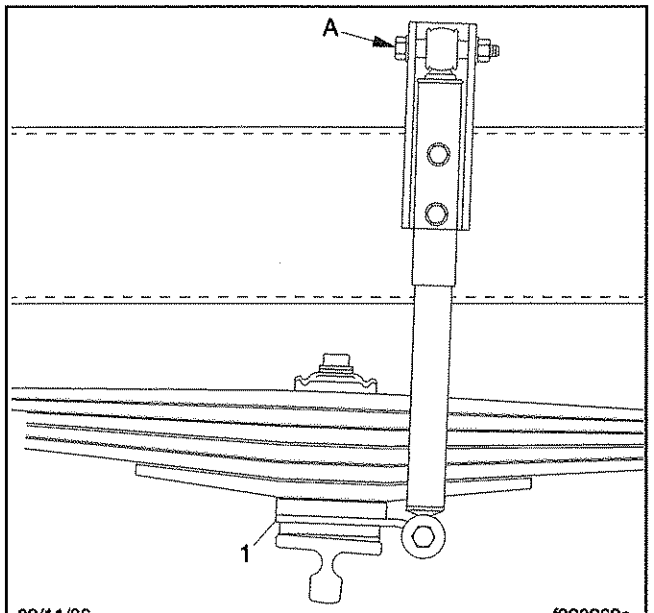


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1. Frame Rail
2. Shock Absorber Upper Mounting Bolt
3. Hardened Washer
4. Shock Absorber Upper Mounting Bracket
5. Hexnut
6. Hexnut, 1/2–13, Class C
7. Spring Pin
8. Zerk Fitting
9. Spring Shackle
10. Bearing Washer
11. Spring Shackle Bolt, 1/2–13 x 3.5
12. Spring Shim Washer
13. Rear Shackle Bracket
14. Spacer
15. Shock Absorber
16. Hexnut
17. Hardened Washer
18. Shock Absorber Lower Mounting Bolt
19. U-Bolt, 7/8–14
20. Axle Stop
21. Hexnut, 1/2–13, Class C
22. Bearing Washer
23. Front Spring Bracket Bolt, 1/2–13 x 3.5
24. Spring Assembly
25. Shock Absorber Lower Mounting Bracket
26. Spacer
27. Dowel Pin
28. Axle Mounting Bracket
29. Axle
30. Hardened Washer
31. High Hexnut, 7/8–14
32. Front Spring Bracket

Fig. 1, All-Wheel-Drive Front Suspension (exploded)

All-Wheel-Drive Components Removal, Cleaning and Inspection, and Installation



A. Loosen the shock absorber upper mounting bolt.
1. Shock Absorber Lower Mounting Bracket

Fig. 2, Shock Absorber Lower Mounting Bracket Removal

1. If the shackle bracket and spring pin or bolt were removed, install them. If necessary, tighten the mounting bolts 135 lbf·ft (183 N·m).

NOTE: All suspension bracket (frame) fasteners require periodic retightening. Refer to the vehicle maintenance manual for the recommended intervals.

2. If the spring shackle was removed, install it. Don't tighten the upper bolt in the shackle at this time.
3. Install the spring assembly.
   - 3.1 Lift the spring into position. See **Fig. 4.** Install the spring eye bolt or spring pin at the front of the spring (see **Fig. 3**) and the lower bolt or spring pin in the shackle at the rear of the spring.
   - 3.2 If necessary, tighten the spring eye bolt and the bolts at the top and bottom of the shackle 240 lbf·ft (325 N·m).
   - 3.3 Apply Alumilastic® or a similar compound to the top and bottom of the spring spacer and any caster adjustment shims.

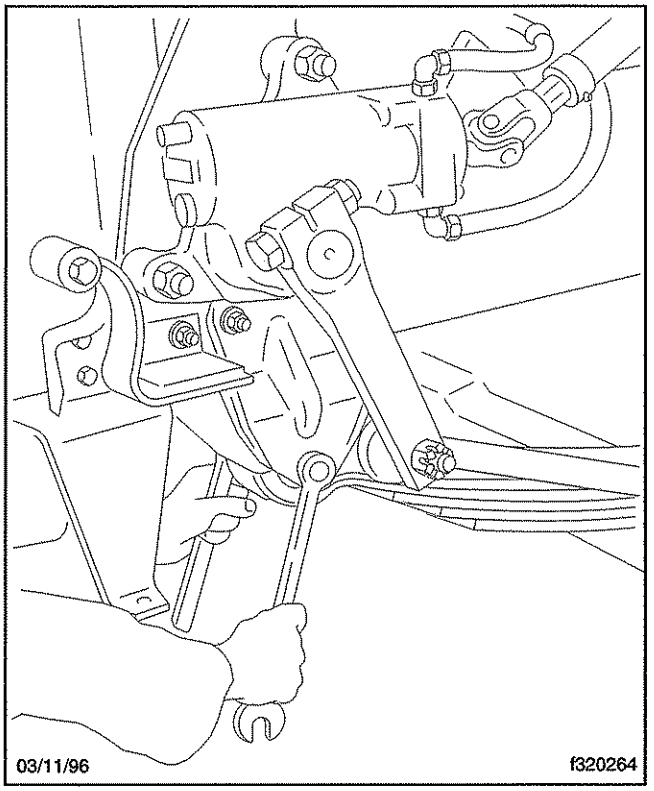


Fig. 3, Spring Eye Fastener Removal/Installation (bolt shown)

⚠ CAUTION

Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel parts contact each other, could lead to corrosion of the metals, resulting in damage to suspension parts.

- 3.4 Place the spring spacer on the axle.
- 3.5 Place the U-bolt pad in position on the leaf spring.
- 3.6 Using a jack, lift the axle into position.
- 3.7 If so equipped, position the shock absorber lower mounting bracket between the leaf spring and the spring spacer.

IMPORTANT: Use new U-bolts when installing the all-wheel-drive assembly.

- 3.8 Install the new U-bolts over the spring leaves, shock absorber lower mounting

All-Wheel-Drive Components Removal, Cleaning and Inspection, and Installation

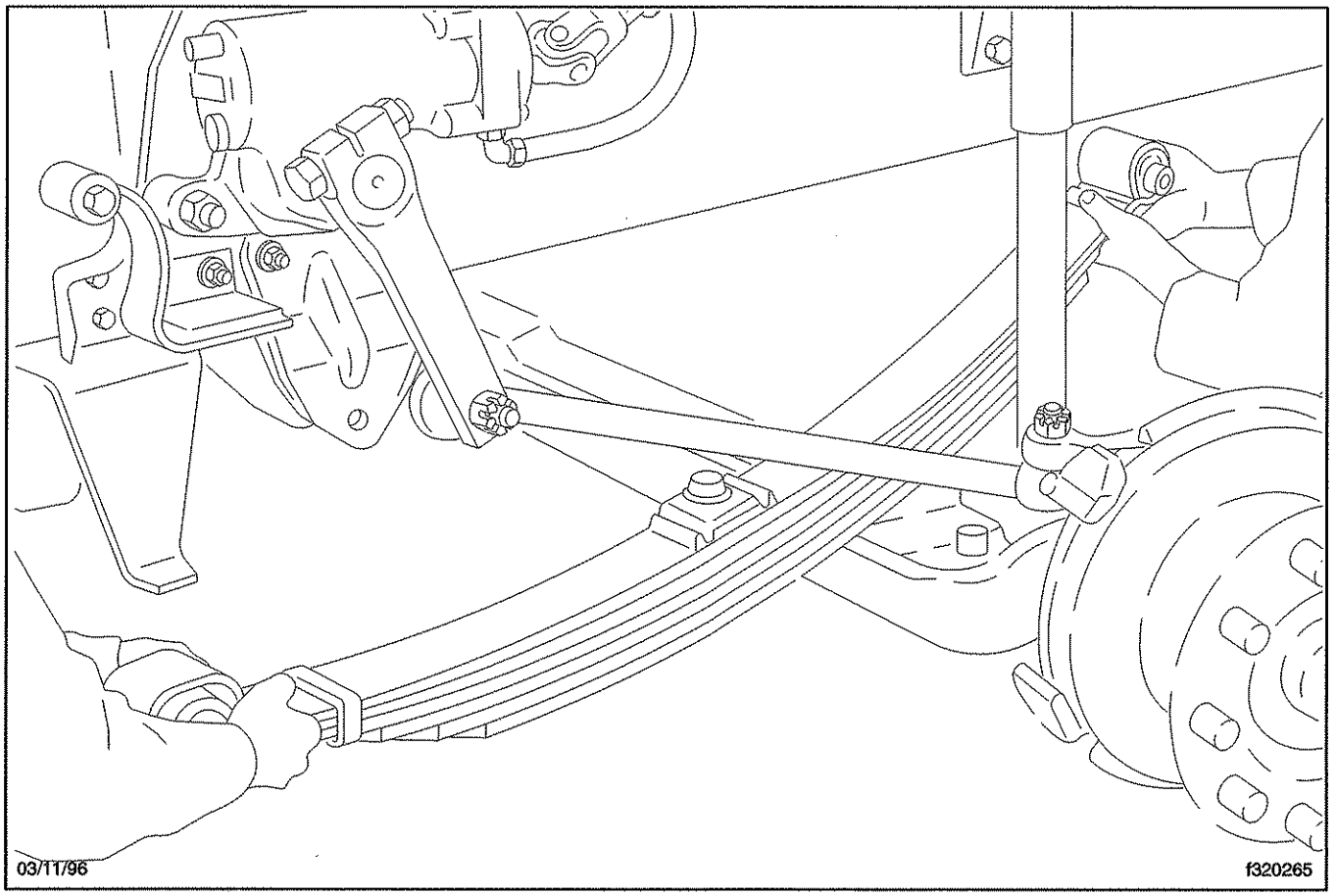


Fig. 4, Spring Removal/Installation

bracket, spring spacer, and through the front axle.

3.9 Install the high-nuts on the new U-bolts and tighten them as described in **Specifications 400.**

4. Remove the floor jack and safety stands.
5. Install the half-fender. See **Group 88** for instructions.
6. Install the wheel and tire. See **Group 40** for instructions. Install the front bumper.
7. Lower the hood, and remove the chocks from the tires.

Troubleshooting

This subject contains the following troubleshooting tables:

- Vehicle Leans to One Side
- Vehicle Wanders
- Vehicle Bottoms Out
- Frequent Spring Breakage
- Noisy Spring
- Rough Ride

Problem—Vehicle Leans to One Side

Possible Cause	Remedy
One or more spring leaves are broken.	Replace the spring assembly.
The spring assembly is weak or fatigued.	Replace the spring assembly.
Unmatched spring-design/load-capacity spring assemblies are installed.	Install the correct spring assemblies as originally specified for the vehicle.
A frame rail is bent or twisted.	Check the frame rails for bends and twists. Correct as needed.

Problem—Vehicle Wanders

Possible Cause	Remedy
One or more spring leaves are broken.	Replace the spring assembly.
The wheels are out of alignment.	Adjust the wheel alignment using the instructions in the **front axle group.**
Caster is incorrect.	Install correct caster shims. Refer to the **front axle group** for specifications.
Steering gear is not centered.	Adjust steering using the instructions in the **steering group.**
Drive axle is out of alignment.	Align the drive axle using the instructions in the **rear axle group.**

Problem—Vehicle Bottoms Out

Possible Cause	Remedy
Excessive weight on the vehicle is causing an overload.	Reduce the loaded vehicle weight to the maximum spring capacities.
One or more spring leaves are broken.	Replace the spring assembly.
The spring assembly is weak or fatigued.	Replace the spring assembly.

Problem—Frequent Spring Breakage

Possible Cause	Remedy
The vehicle is overloaded or operated under severe conditions.	Reduce the loaded vehicle weight to the maximum spring capacities. Caution the driver on improper vehicle handling.
There is insufficient torque on the U-bolt high nuts.	Torque the U-bolt high nuts to the value listed in the torque table in **"Specifications, 400."**
A loose center bolt is allowing the spring leaves to slip.	Check the spring leaves for damage. If damaged, replace the spring assembly. If not, tighten the center-bolt nut to the value listed in the torque table in **"Specifications, 400."**
Worn or damaged spring bushings are allowing spring end-play.	Replace the spring bolt and bushing.
A loose spring bolt is allowing spring end-play.	Replace the spring bolt and bushing.

Troubleshooting

Problem—Noisy Spring

Possible Cause	Remedy
A loose U-bolt nut or center bolt is allowing spring leaf slippage.	Inspect the components for damage. Replace damaged components as necessary. Torque all fasteners to the values listed in the torque table in **"Specifications, 400."**
A loose, bent, or broken spring shackle or front suspension bracket is impairing the spring flex.	Inspect the shackles and brackets for damage. Replace damaged components as necessary. Torque the fasteners to the values listed in the torque table in **"Specifications, 400."**
Worn or damaged spring bolts are allowing spring end-play.	Replace any worn or damaged spring bolts.
Worn or damaged spring bushings are allowing spring end-play.	Replace the spring bolt and bushing.

Problem—Rough Ride

Possible Cause	Remedy
Refer to the applicable section in this group.	

Description	Size	Torque: lbf·ft (N·m)
Shackle Bracket Bolt	3/4–10	135 (183)
Shackle Bracket Mounting Bolt	5/8–11	135 (183)
Spring Eye Bolt	3/4–10	135 (183)
Shock Absorber Mounting Capscrews	3/4–10	110 (149)
U-Bolt High Nut (Tighten in a diagonal pattern as shown in **Fig. 1**.)	5/8–18	Stage 1: Hand tighten Stage 2: 60 (80) Stage 3: 200 (271) Stage 4: 180–230 (245–313)
	3/4–16	Stage 1: Hand tighten Stage 2: 60 (80) Stage 3: 200 (271) Stage 4: 270–330 (367–449)
	7/8–14	Stage 1: Hand tighten Stage 2: 60 (80) Stage 3: 200 (271) Stage 4: 420–500 (571–680)

Table 1

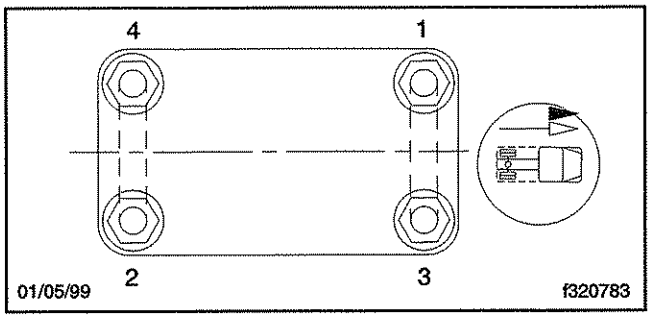


Fig. 1, Tightening Pattern for U-bolt High Nuts

Rear Leaf Spring Suspension 32.01

Contents

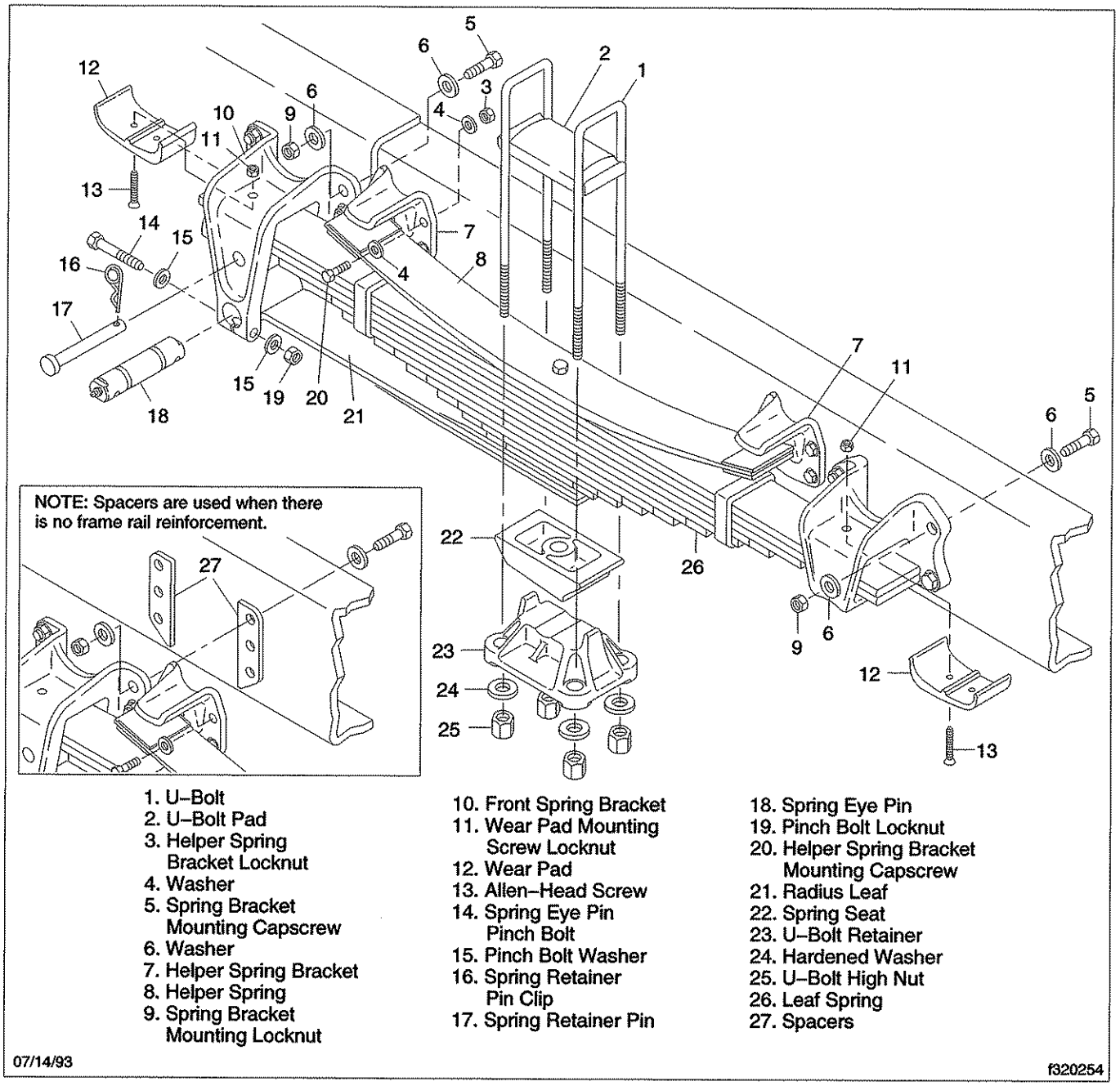
Subject	Subject Number
General Description	050
Service Operations	
Spring Assembly Replacement	100
Spring Bracket Replacement	110
Spring Eye Pin Replacement	120
Wear Pad Replacement	130
Shock Absorber Replacement	140
Specifications	400

General Description

The rear leaf spring suspension **(Fig. 1)** uses a slip spring design with varying capacities. Optional helper leaves provide a progressive spring rate and additional roll stability. The spring ends ride in cast iron brackets mounted on the frame rails. Each spring bracket holds a replaceable wear pad. The spring assemblies are attached to the axle with U-bolt assemblies. A radius leaf attaches each spring assembly to its forward spring bracket and holds the axle in alignment.

Shock absorbers are optional with all suspension capacities.

General Description



1. U–Bolt
2. U–Bolt Pad
3. Helper Spring Bracket Locknut
4. Washer
5. Spring Bracket Mounting Capscrew
6. Washer
7. Helper Spring Bracket
8. Helper Spring
9. Spring Bracket Mounting Locknut
10. Front Spring Bracket
11. Wear Pad Mounting Screw Locknut
12. Wear Pad
13. Allen–Head Screw
14. Spring Eye Pin Pinch Bolt
15. Pinch Bolt Washer
16. Spring Retainer Pin Clip
17. Spring Retainer Pin
18. Spring Eye Pin
19. Pinch Bolt Locknut
20. Helper Spring Bracket Mounting Capscrew
21. Radius Leaf
22. Spring Seat
23. U–Bolt Retainer
24. Hardened Washer
25. U–Bolt High Nut
26. Leaf Spring
27. Spacers

Fig. 1, Leaf Spring Suspension

Replacement

1. Lift the rear axle and support it with safety stands. Lift the vehicle frame to take weight off the rear springs.
2. Remove the U-bolt high nuts; then, remove the U-bolts. See **Fig. 1**.
3. Remove the spring eye pin that attaches the radius leaf to the front spring bracket.

   3.1 Using a C-clamp, take the load off the radius leaf. See **Fig. 2**.

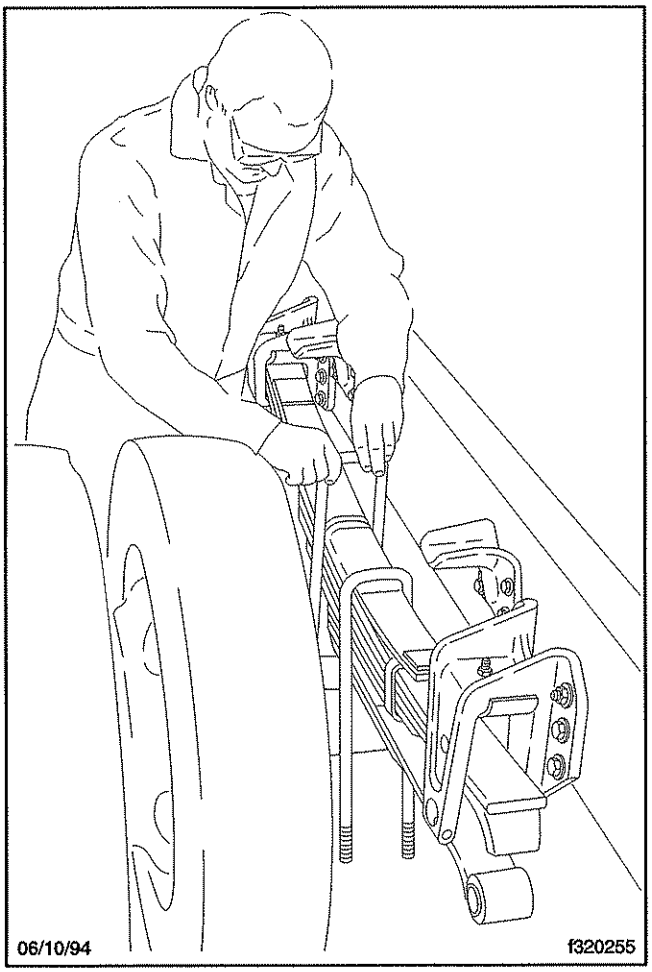


Fig. 1, Removing the U-bolts

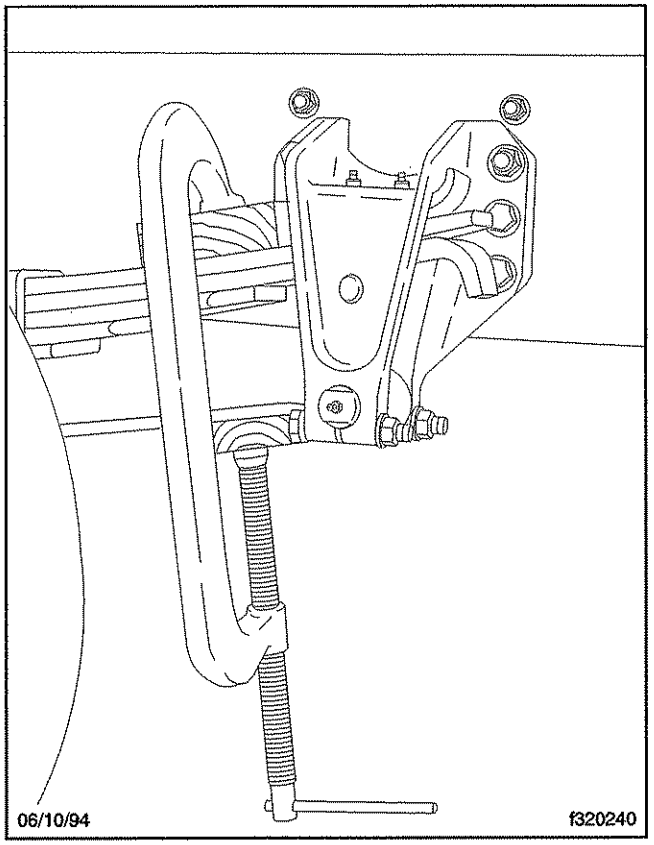


Fig. 2, Compress Springs to Remove Eye Pin

⚠ WARNING

Failure to use a C-clamp may cause components to be forcibly ejected, possibly causing serious personal injury.

   3.2 Remove the pinch bolts. See **Fig. 3**.

   3.3 Using a brass hammer and drift, tap the eye pin out. See **Fig. 4**.

4. Remove the clip (**Fig. 5**) and the spring retainer pin (**Fig. 6**).

⚠ WARNING

The leaf spring assembly is heavy. Always use two people when moving it, to avoid personal injury.

5. Remove the spring assembly.

Spring Assembly Replacement

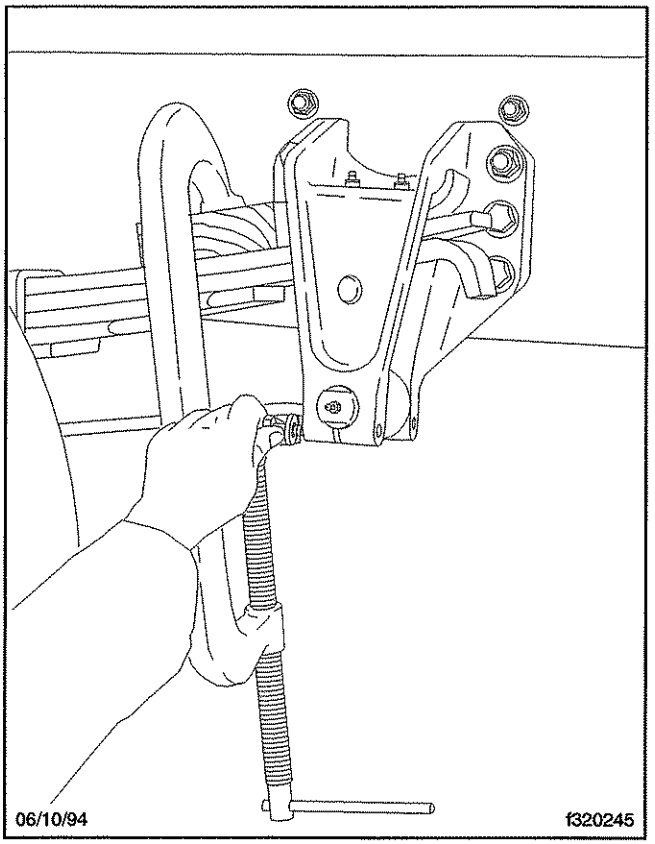


Fig. 3, Removing/Installing the Pinch Bolts

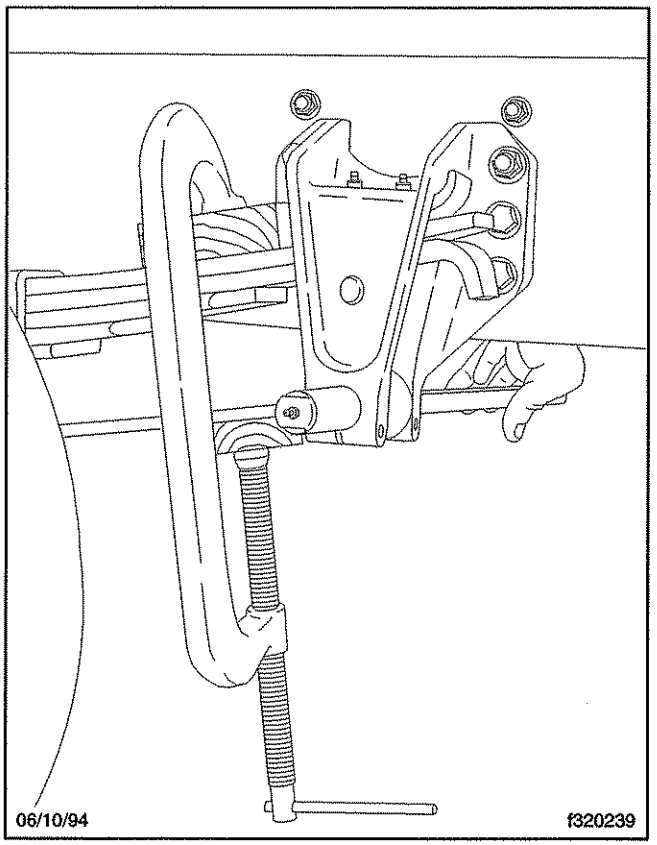


Fig. 4, Removing Eye Pin from Radius Leaf

5.1 If the vehicle is equipped with the optional helper spring, lift it off. See **Fig. 7**.

5.2 Slide the leaf spring assembly forward and remove it from the vehicle. See **Fig. 8**.

6. Inspect the wear pads for wear. Replace them if needed. For instructions, see **Subject 130**.

7. Install the new spring assembly.

   7.1 Position the new spring on the axle seat.

   NOTE: It may be necessary to raise the frame slightly.

   7.2 Lower the frame until the spring is properly located between the spring brackets.

   7.3 If equipped with the optional auxiliary spring, place it on the main spring.

8. Install the U-bolts and the U-bolt retainer. The taller end of the retainer must be towards the front of the vehicle. See **Fig. 9**.

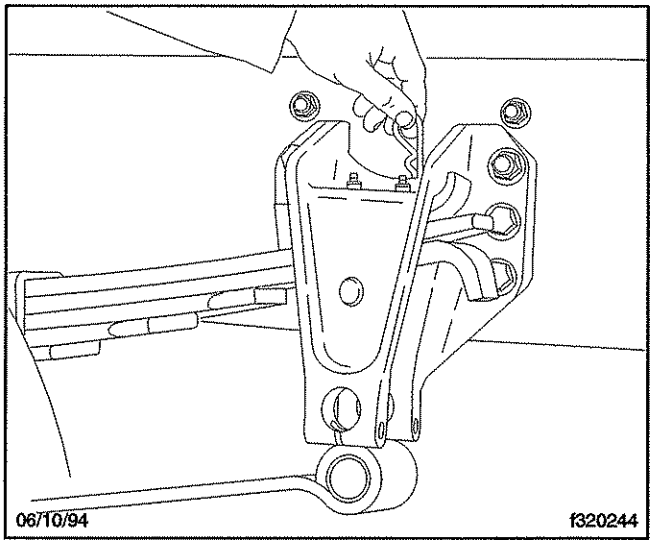


Fig. 5, Removing/Installing Retainer Pin Clip

9. Install the U-bolt high nuts (**Fig. 10**), but don't tighten them now.

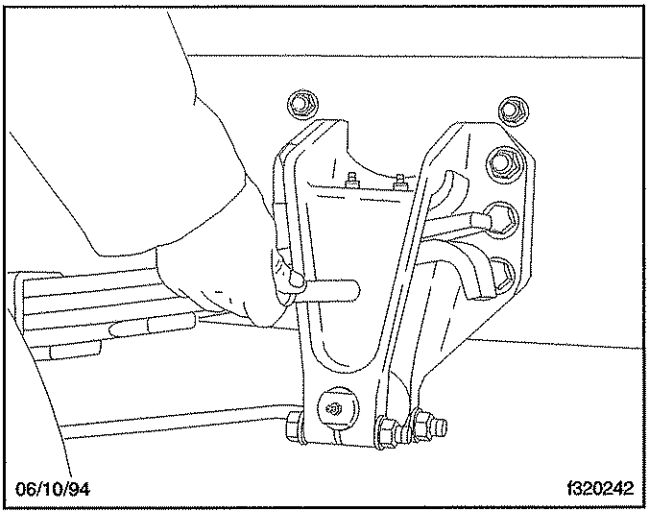


Fig. 6, Removing the Retainer Pin

10. Lift the spring above the hole for the spring retainer pin in the front spring bracket; then, insert the retainer pin. See **Fig. 11**.
11. Install the clip on the pin. See **Fig. 5**.
12. Install the spring eye pin.
    - 12.1 Using a C-clamp, compress the spring until the front spring eye pin can be installed. See **Fig. 12**.
    - 12.2 Inspect the pin for wear or damage. Replace it with a new pin if necessary.
    - 12.3 Using a brass hammer, tap the pin into position. See **Fig. 12**.
    - 12.4 Install the pinch bolts and nuts. See **Fig. 3**. Tighten the nuts to 32 lbf·ft (43 N·m).
    - 12.5 Remove the C-clamp.
13. Tighten the U-bolt high nuts as described in **Specifications 400**.
14. Remove the jack or safety stands from the rear axle and the frame.

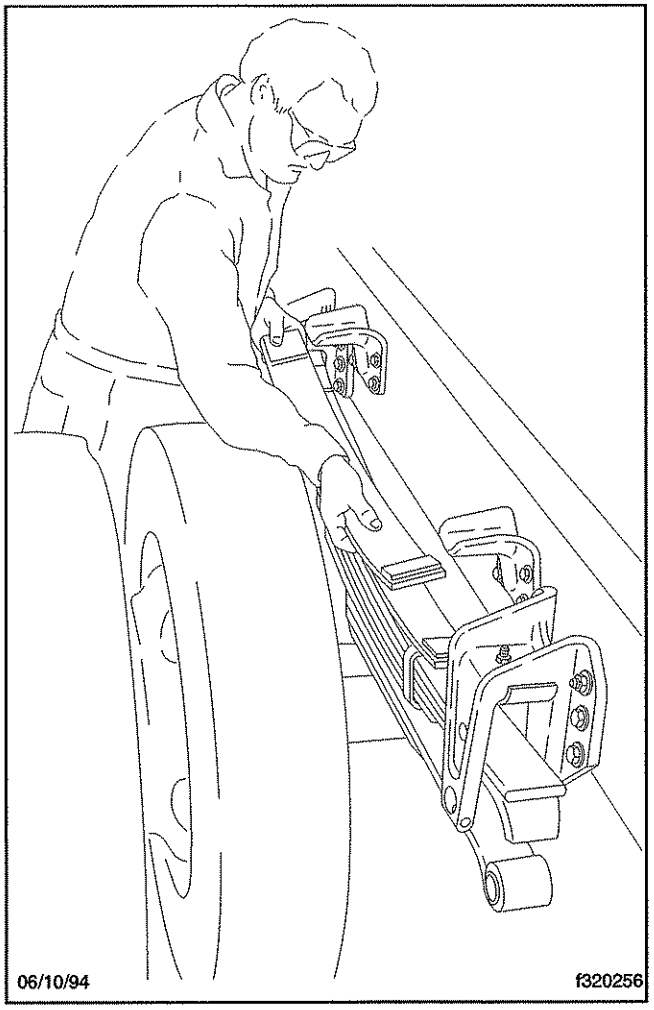


Fig. 7, Removing the Optional Helper Spring

Spring Assembly Replacement

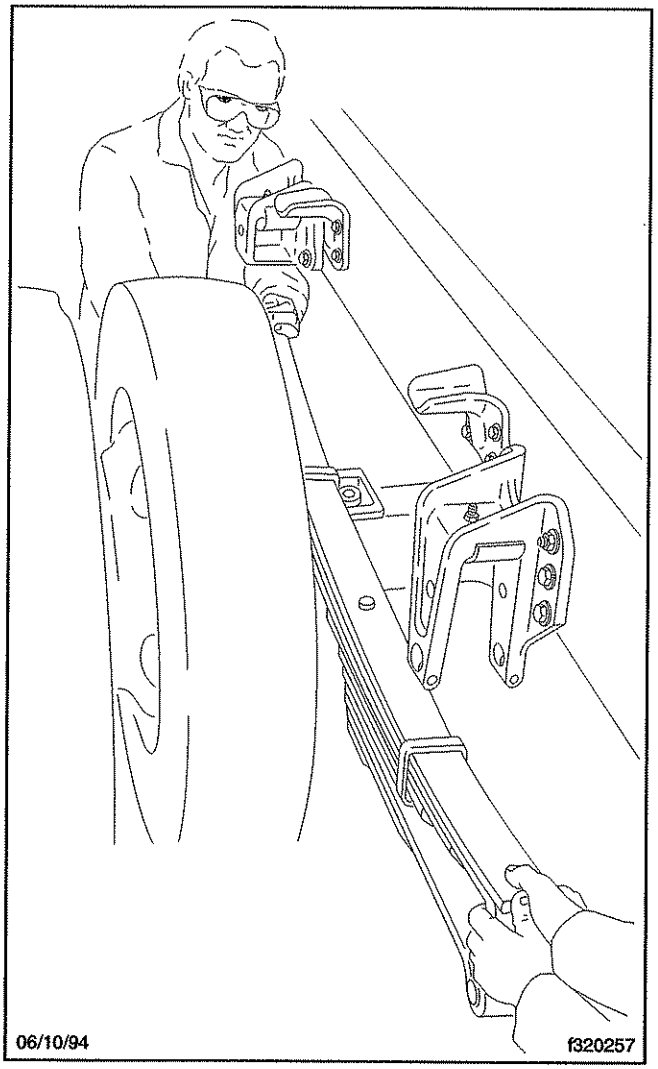
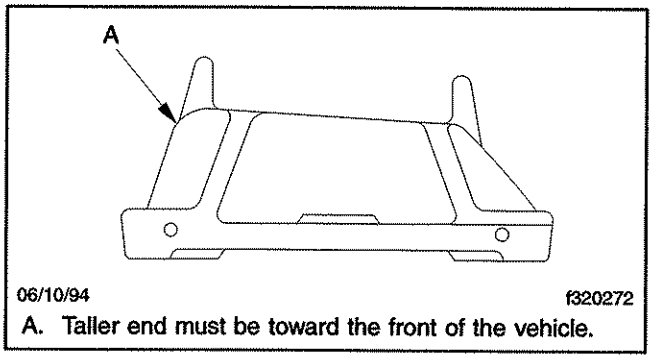


Fig. 8, Removing the Leaf Spring Assembly



A. Taller end must be toward the front of the vehicle.

Fig. 9, Alignment of the U-bolt Retainer

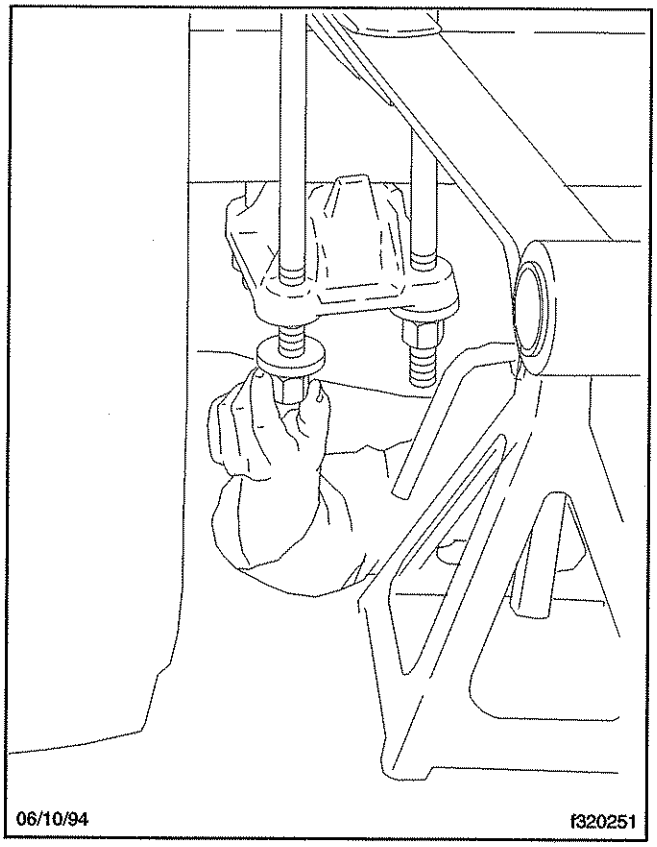


Fig. 10, Installing the U-bolt High Nuts

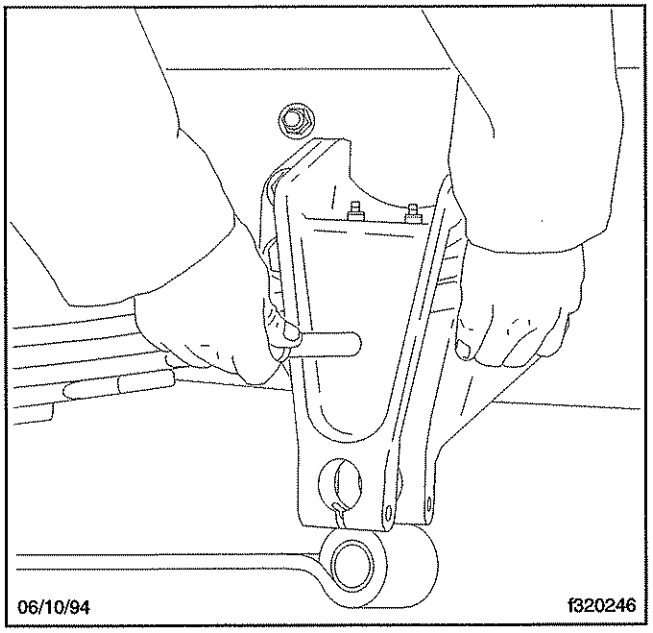


Fig. 11, Installing the Retainer Pin

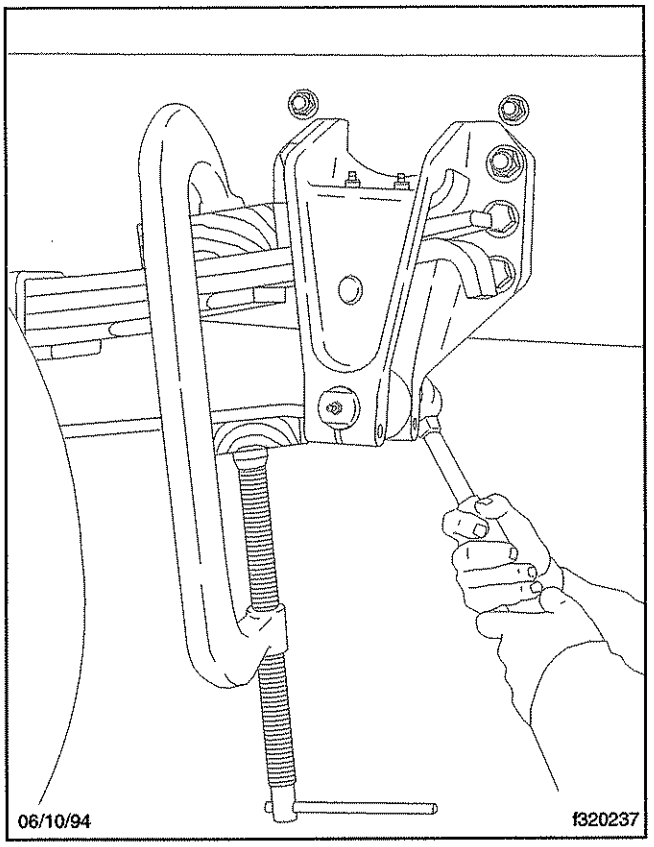


Fig. 12, Installing the Spring Eye Pin

Rear Spring Bracket Replacement

1. Park the vehicle and chock the front tires.
2. Jack up the frame rail at the rear of the vehicle until the leaf spring is floating free in the rear spring bracket.
3. Remove the fasteners holding the rear spring bracket to the frame rail. See **Fig. 1**.
4. Slide the spring bracket off the end of the leaf spring assembly. See **Fig. 2**.
5. Check the wear pad for wear. Replace it if needed. For instructions, refer to **Wear Pad Replacement, 130**.
6. Slide the new spring bracket into position.
7. Install the fasteners and tighten them 184 N·m (135 lbf·ft).
8. Lower the frame rail and remove the chocks from the tires.

Forward Spring Bracket Replacement

1. Park the vehicle and chock the front tires.
2. Jack up the frame rail at the rear of the vehicle until the weight is removed from the leaf spring.
3. Remove the spring bracket.
   - 3.1 Using a C-clamp, take the load off the radius leaf. See **Fig. 3**.
   - 3.2 Remove the pinch bolts holding the spring eye pin. See **Fig. 4**.
   - 3.3 Using a brass hammer, tap out the spring eye pin. See **Fig. 5**.
   - 3.4 Remove the clip (see **Fig. 6**) and the spring retainer pin (see **Fig. 7**).
   - 3.5 Remove the fasteners holding the front spring bracket to the frame rail.
   - 3.6 Slide the spring bracket off the front of the leaf spring assembly.
4. Install a new spring bracket.
   - 4.1 Slide a new spring bracket into position.
   - 4.2 Install the fasteners and tighten them 325 N·m (240 lbf·ft).
   - 4.3 While lifting the spring, install the spring retainer pin and clip. See **Fig. 7**.
   - 4.4 Using a hammer, drive in the spring eye pin. See **Fig. 8**.

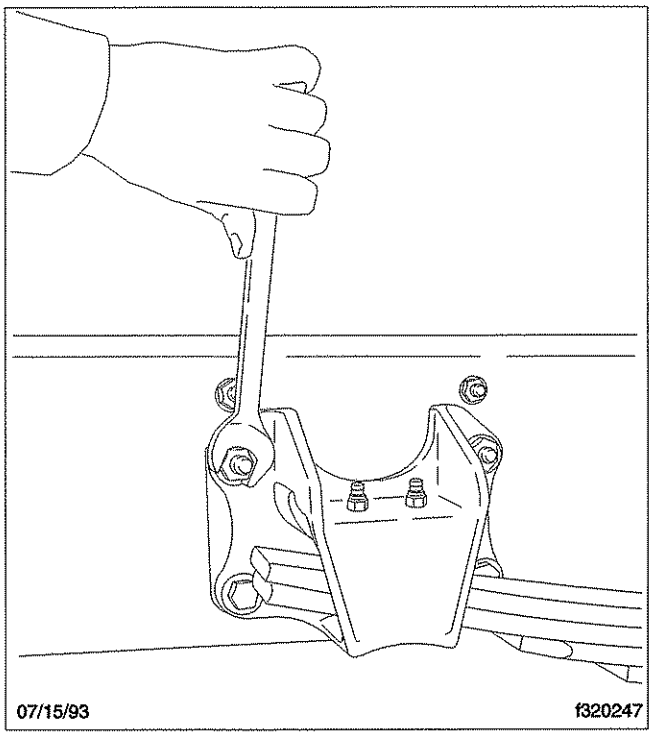


Fig. 1, Rear Spring Bracket Fastener Removal

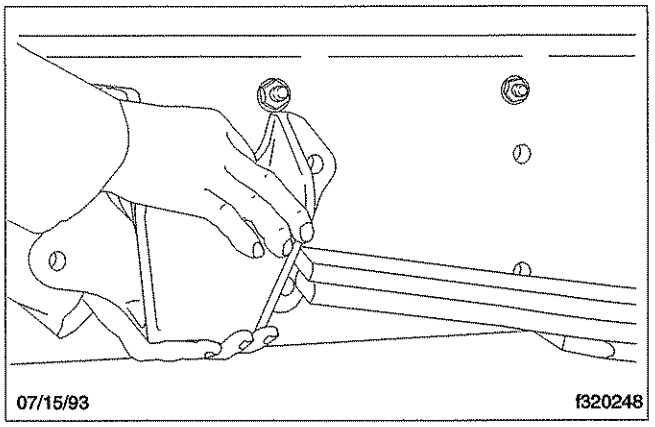


Fig. 2, Sliding Bracket From Leaf Spring Assembly

Spring Bracket Replacement

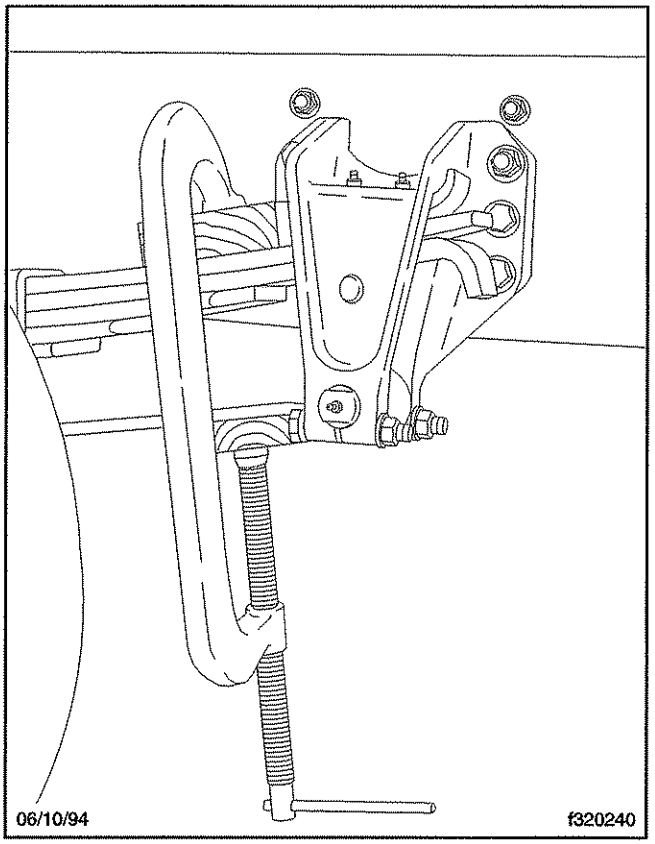


Fig. 3, C-Clamping Radius Leaf

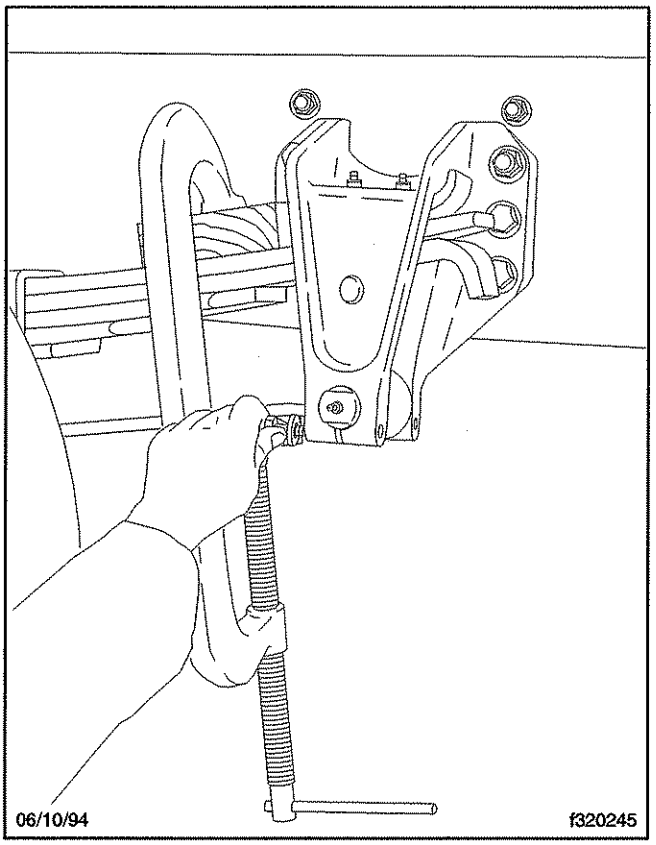


Fig. 4, Removing Pinch Bolts

4.5 Install the pinch bolts and nuts. Tighten the nuts 43 N·m (32 lbf·ft).

5. Lower the frame rail and remove the chocks from the tires.

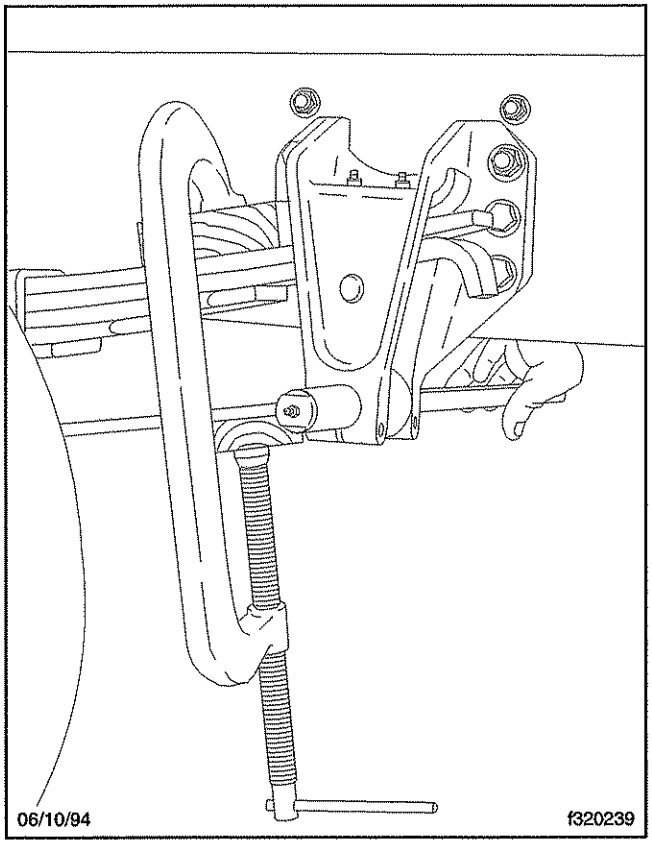


Fig. 5, Tap Out Spring Eye Pin

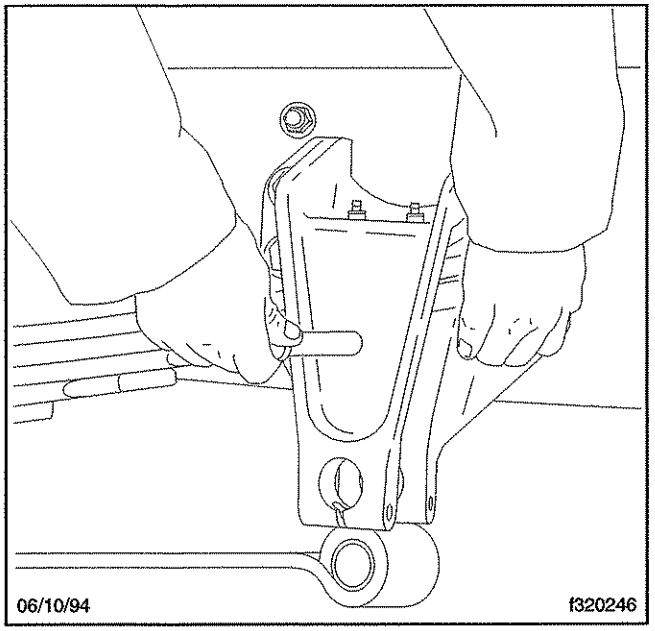


Fig. 7, Spring Retainer Pin Removal

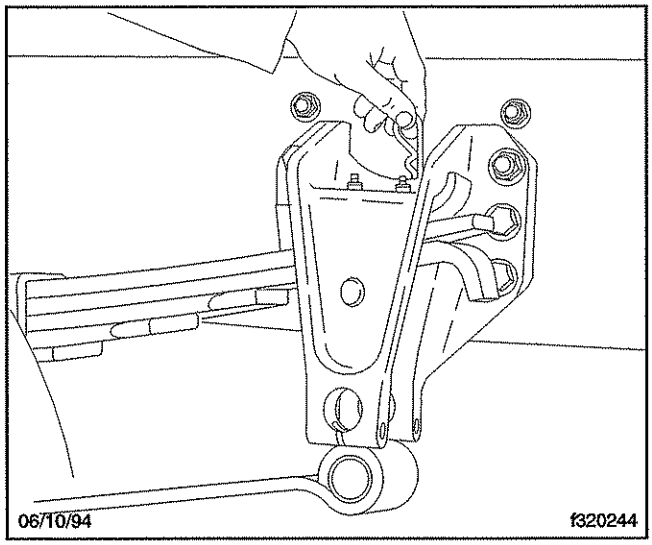


Fig. 6, Clip Removal

Spring Bracket Replacement

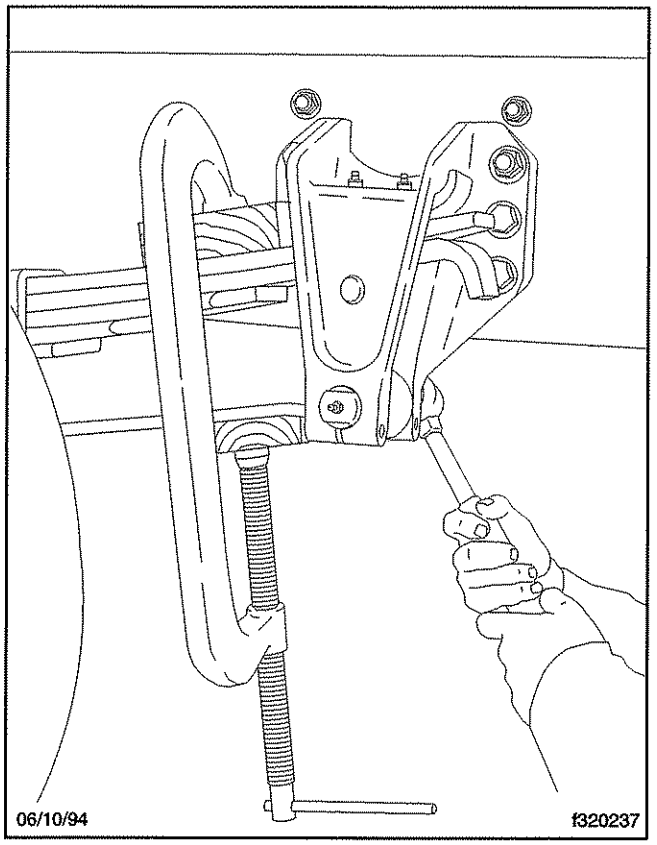


Fig. 8, Spring Eye Pin Installation

Spring Eye Pin Replacement

Replacement

1. Using a floor jack, lift the frame rail to take weight off the spring.
2. Using a C-clamp, take the load off the radius leaf. **See Fig. 1.**
3. Loosen and remove the pinch bolts. **See Fig. 2.**
4. Using a brass hammer and a drift, tap the pin out. **See Fig. 3.**
5. Grease the outer surface of a new pin and insert it **(Fig. 4).** Drive it in using a hammer. **See Fig. 5.**
6. Install the pinch bolts **(Fig. 2)** and nuts. Tighten the nuts 43 N·m (32 lbf·ft)
7. Install a new zerk fitting and the spring eye pin.
8. Remove the C-clamp and lower the jack.

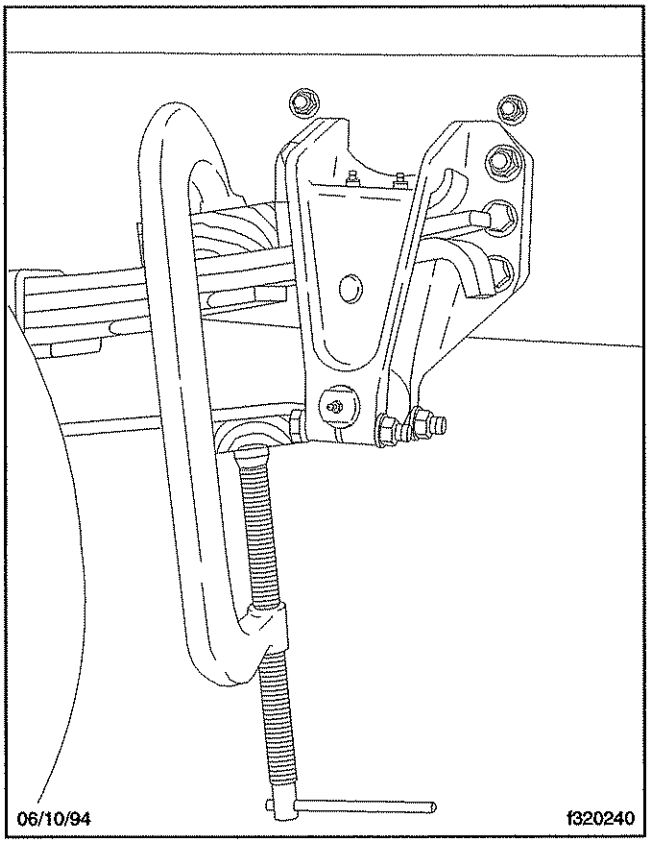


Fig. 1

NOTE: When replacing the pin, if the spring has shifted, loosen the U-bolt nuts so the spring can be shifted fore and aft.

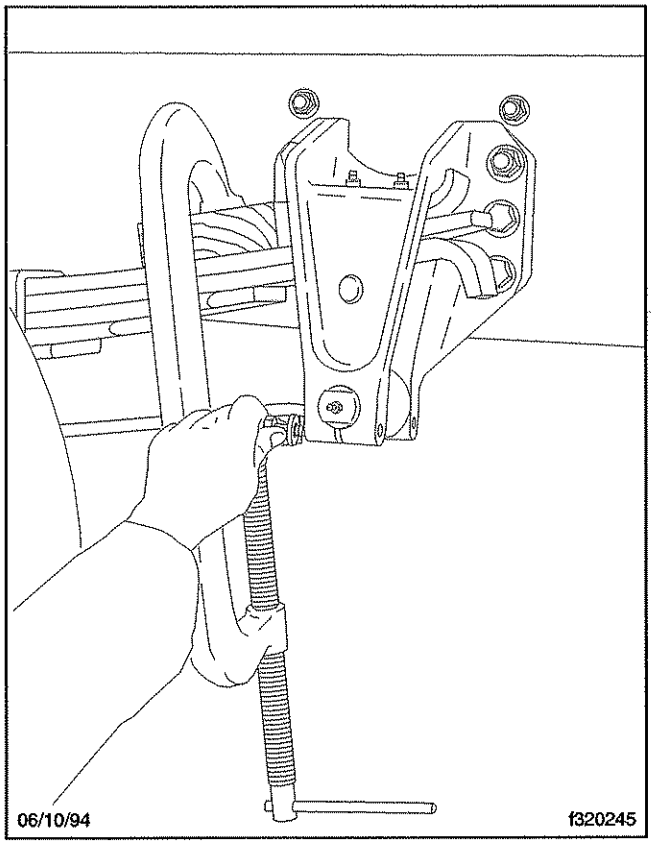


Fig. 2

Spring Eye Pin Replacement

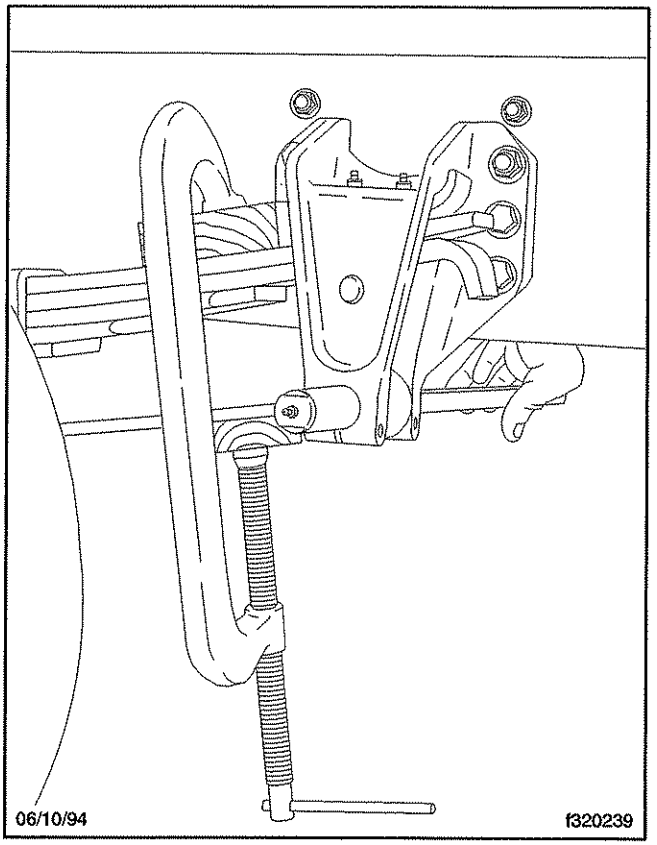


Fig. 3

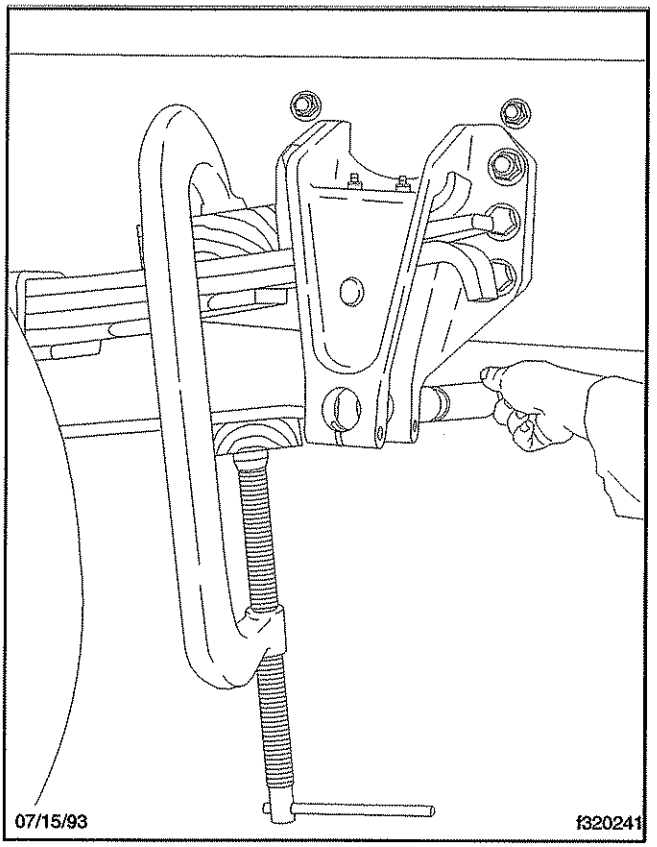


Fig. 4

Spring Eye Pin Replacement

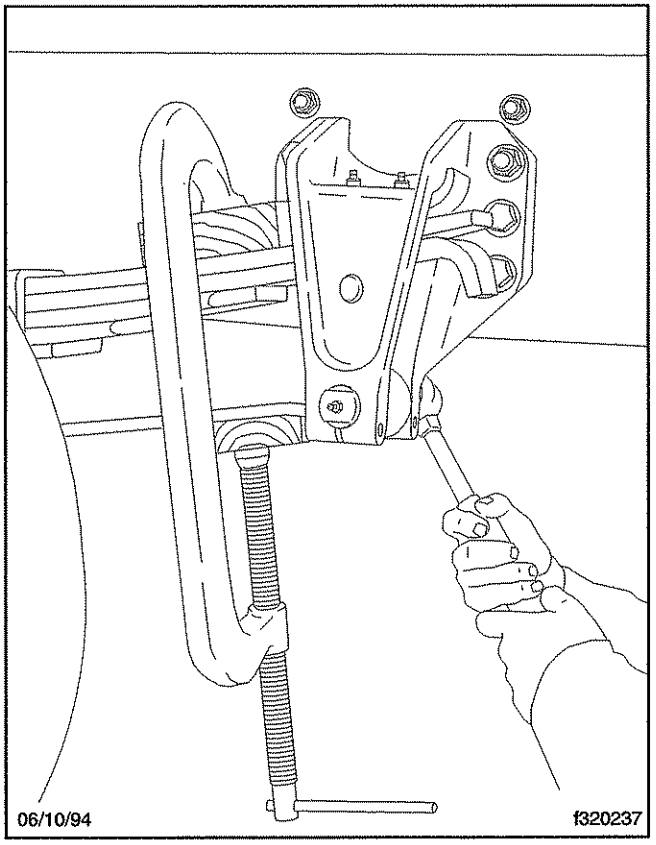


Fig. 5

Wear Pad Replacement

Replacement

NOTE: Wear pads can be replaced without removing the leaf spring assemblies.

1. Park the vehicle and chock the front tires.
2. For front wear pad replacement, remove the clip **(Fig. 1)** and the spring retainer pin **(Fig. 2).**
3. Using a floor jack or a crane, take the weight off the frame rail so there is no contact between the spring and the wear pad.
4. Remove the allen-head screws attaching the wear pad to the spring bracket. **See Fig. 3** for the front wear pad, **Fig. 4** for the rear wear pad. Remove and discard the wear pad.
5. Install the new wear pad so that the thicker portion of the pad is toward the axle. **See Fig. 5** for the front wear pad. While holding it in place, install and tighten the allen-head screws until snug.
6. If removed, install the spring retainer pin and its clip.
7. Lower the frame rail.

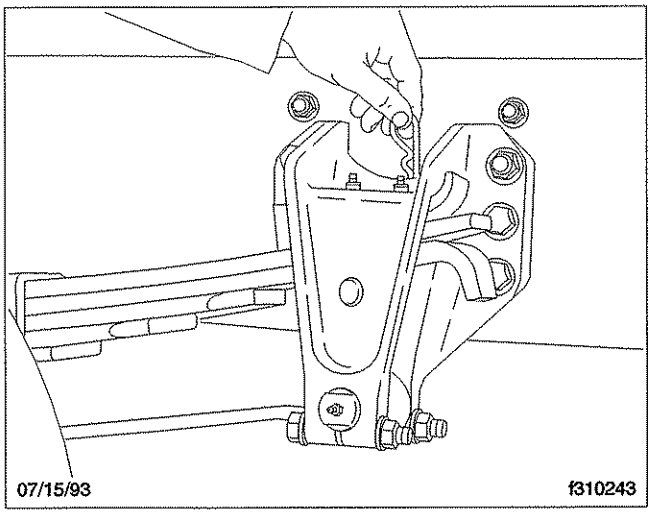


Fig. 1

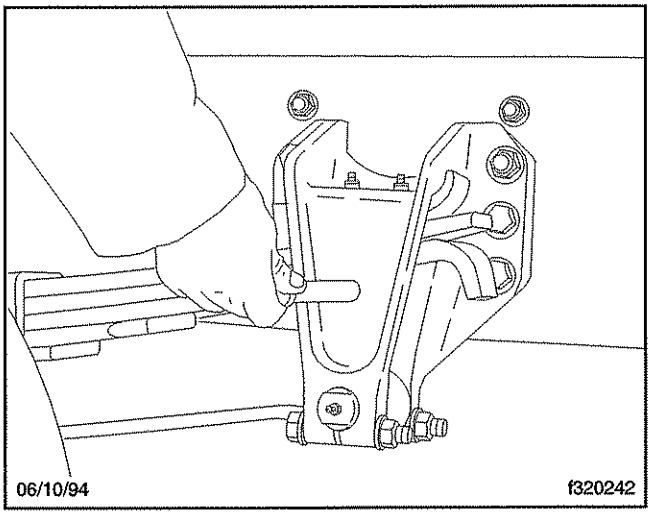


Fig. 2

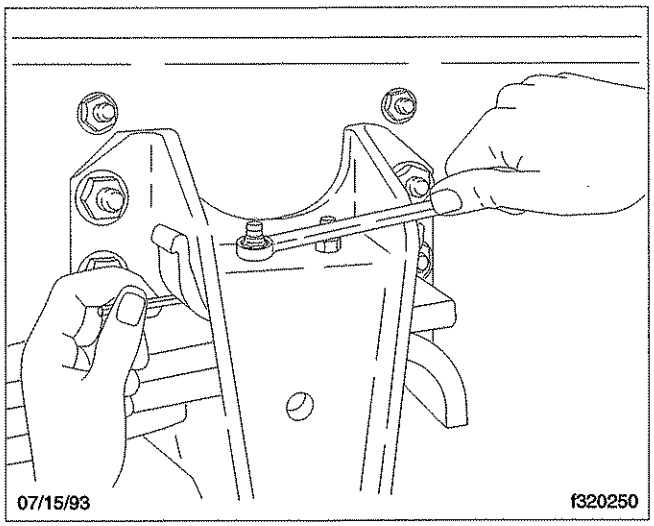


Fig. 3

Wear Pad Replacement

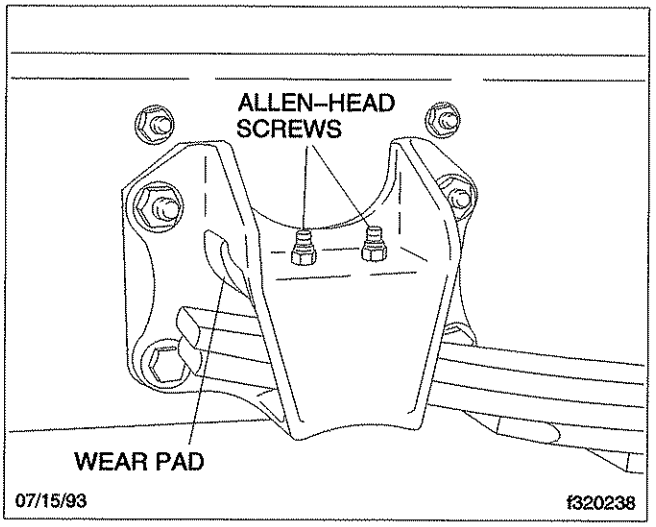


Fig. 4

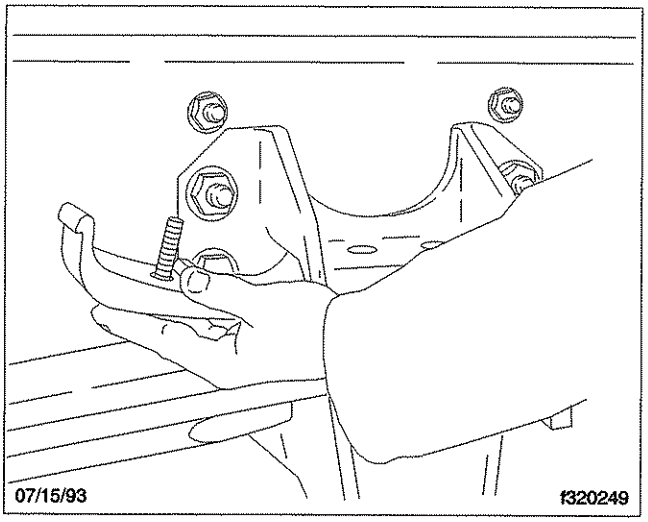


Fig. 5

Shock Absorber Replacement

Replacement (See Fig. 1)

1. Chock the tires and apply the parking brakes.
2. Remove the locknut, retainers, and bushings from the shock absorber lower mount.
3. Remove the locknut, capscrew, and washers from the shock absorber upper mount.
4. Remove the shock absorber.
5. Install the replacement shock absorber.
6. Install the capscrew and locknut in the upper mount. Hand tighten them at this time.
7. Install the replacement bushings, retainers, and locknut as shown in **Fig. 2.**

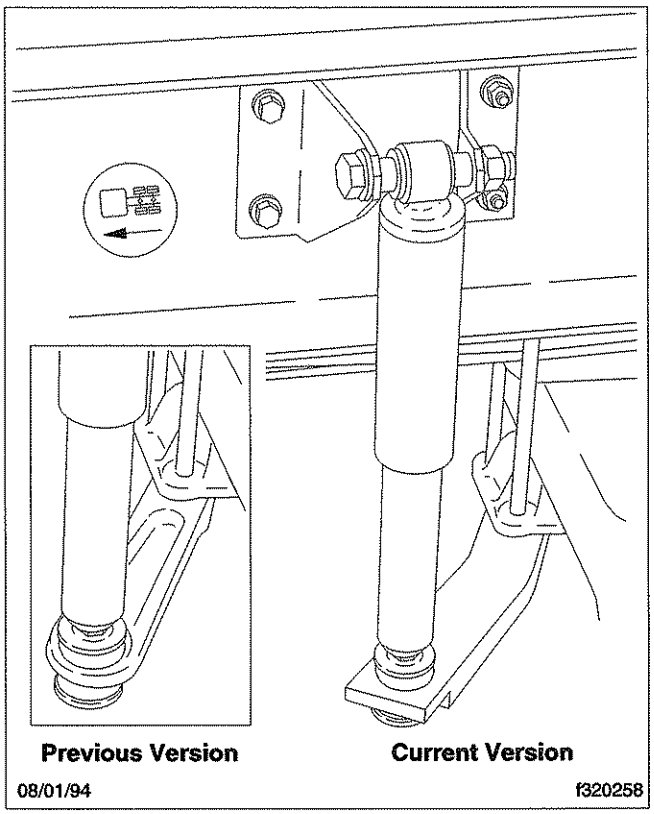


Fig. 1

⚠ WARNING

Use only the retainers included with the replacement shock absorber. Do not use washers. They can be pushed over the nut and be ejected violently, possibly causing personal injury and property damage.

8. Tighten the shock absorber upper mounting locknut 226 N·m (167 lbf·ft).
9. Tighten the shock absorber lower mounting nut to compress the bushings to the dimension shown in **Fig. 2.**

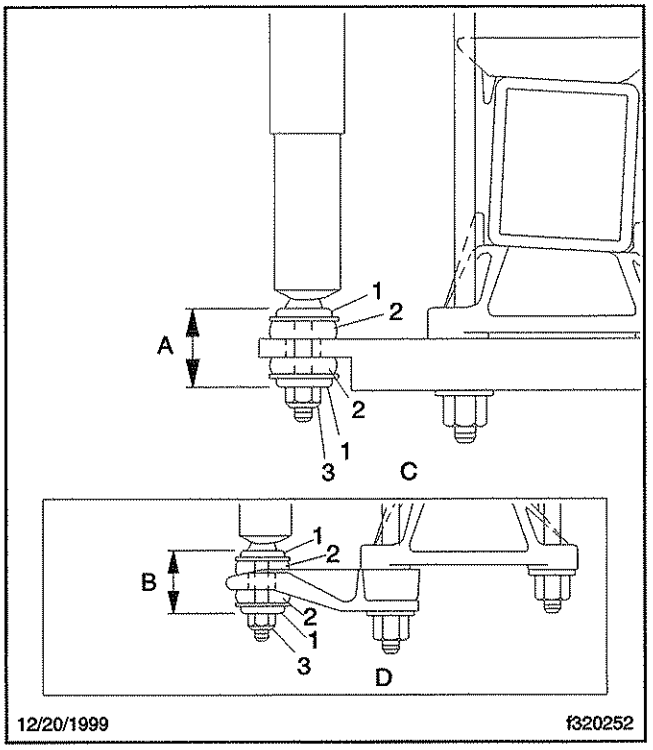


Fig. 2

Specifications

Torque Values			
Description	**Size**	**IFI Grade**	**Torque lbf.ft (N.m)**
Forward Spring Bracket-to-Frame Rail Locknut*	3/4–10	C	240 (325)
Rear Spring Bracket-to-Frame Rail Locknut*	5/8–11	C	135 (184)
Axle U-Bolt High Nuts	5/8–18	C	Stage 1: Hand tighten Stage 2: 60 (81)† Stage 3: 200 (271)† Stage 4: 180 to 230 (245 to 313)†
	3/4–16	C	Stage 1: Hand tighten Stage 2: 60 (81)† Stage 3: 200 (271)† Stage 4: 270 to 330 (367 to 449)†
Spring Eye Pin Pinch Bolts	7/16—14	C	37 (50)
Shock Absorber Upper Locknut	—	C	167 (226)

* Cadmium-plated, wax-coated nuts, and grade 8 hexbolts with phosphate- and oil-coated threads; both used with hardened washers.
† Tighten in a diagonal pattern as shown in **Fig. 1**.

Table 1, Torque Values

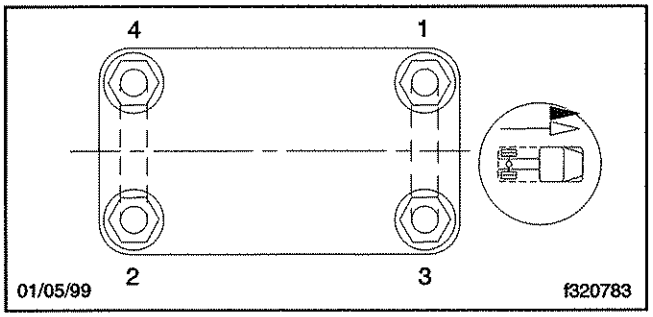


Fig. 1, Tightening Pattern for U-bolt High Nuts

Freightliner AirLiner Suspension 32.02

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General Information

The Freightliner AirLiner Suspension is a single axle or tandem axle suspension that uses a combination of air and leaf springs. The suspension is manufactured at numerous weight ratings up to 46,000 pounds (20 865 kg). The top of the air spring is bolted to a bracket on the frame rail or through the bottom flange of the frame rail; the bottom is bolted to the rear end of the tapered leaf spring assembly or, for the 23,000-pound (10 433 kg) and 46,000-pound suspensions, to a cross bar. The axle housing is fastened to the leaf spring assembly by U-bolts. A control rod, mounted between the axle housing and the frame rail, can be used to help locate the assembly laterally.

The air springs compensate for changes in road conditions and vehicle load, maintaining constant vehicle height. The air springs also absorb road shock.

A height control valve regulates the air flow into or out of the air springs. **See Fig. 1.** Changes in the clearance between the vehicle frame and the differential housing activate the height control valve. Then, the height control valve adjusts the frame height by compression or expansion of the air springs.

The pressure holding valve (**Fig. 1**, Ref. 2), located in the air line to the height control valve, is preset to maintain a minimum pressure of 448 kPa (65 psi) in the vehicle secondary air system if a leak should occur in the air suspension system.

Principles of Operation

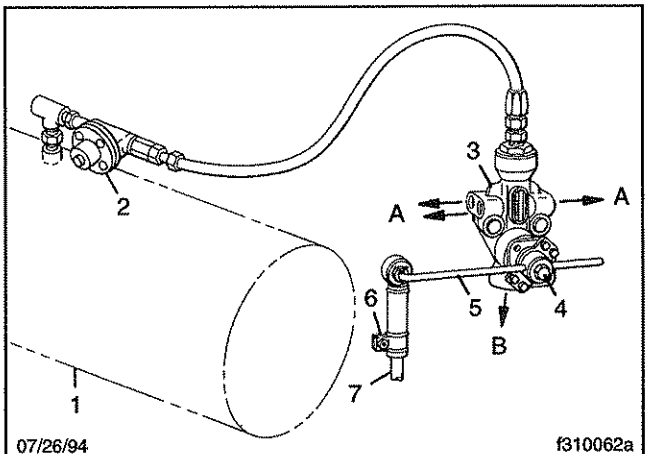
The height control valve controls the air suspension system. All of the air in the system is admitted through or exhausted from this valve.

The height control valve is mounted on a frame crossmember. An overtravel lever extends horizontally from the end of the height control valve control shaft to a linkage arm that connects to the height control valve linkage bracket welded to the differential housing. **See Fig. 2.**

When the load changes, the overtravel lever turns the height control valve control shaft, activating either the intake or exhaust valve section of the height control valve. This adjusts the volume of air in the air springs, until the frame returns to the normal ride height, and the overtravel lever returns to the (horizontal) neutral position.

A 9-second time delay is built into the height control valve to prevent rapid suspension height changes due to bumps. This also reduces the air consumption of the suspension.

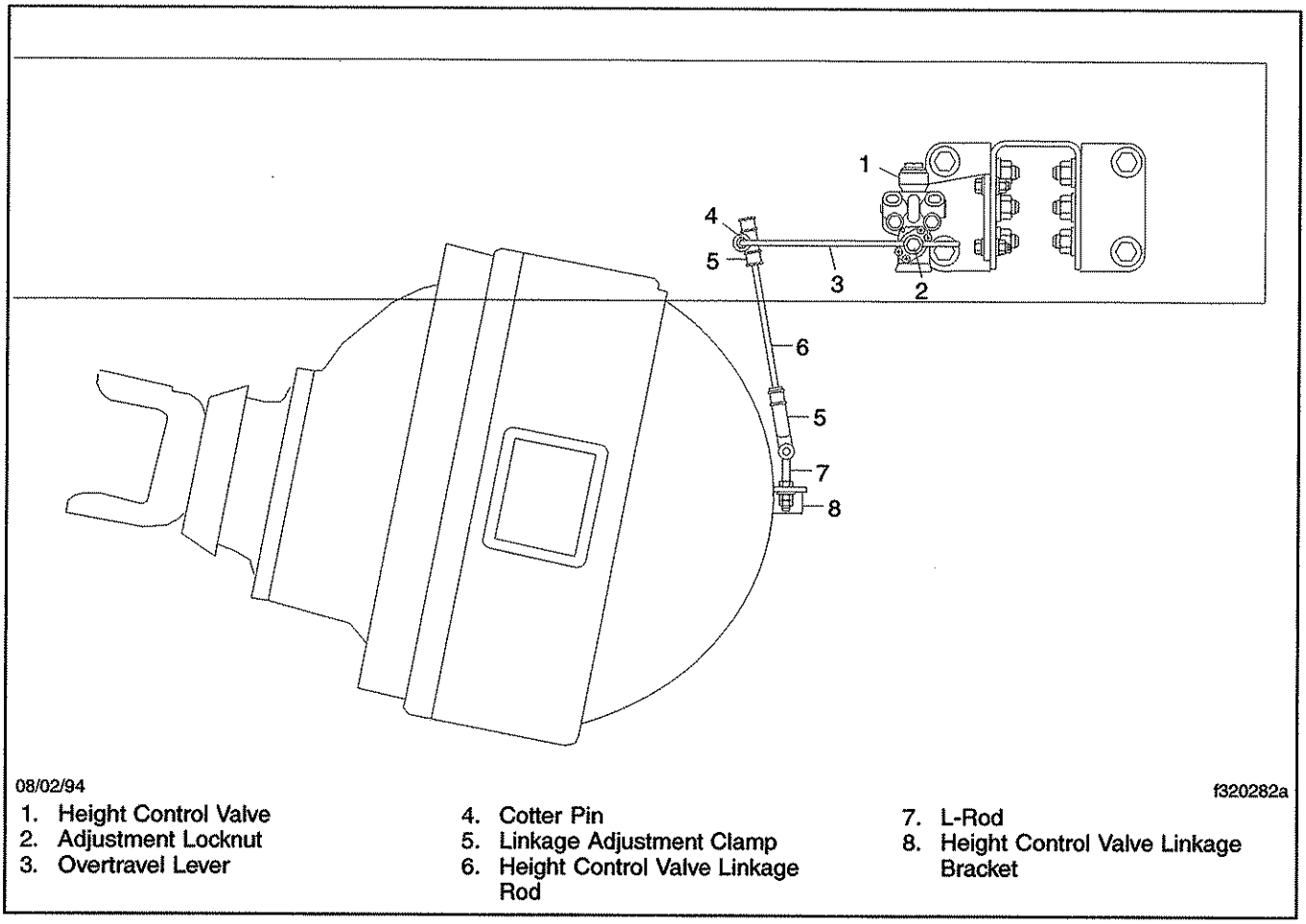
A side-to-side restriction valve inside the height control valve maintains vehicle roll stability by preventing inflation of the air spring on one side and deflation on the other side during curves.



A. To Air Springs
B. To Atmosphere
1. Secondary Air Reservoir
2. Pressure Holding Valve
3. Height Control Valve
4. Adjusting Locknut
5. Overtravel Lever
6. Linkage Adjustment Clamp
7. Height Control Valve Linkage

Fig. 1, Height Control Valve Assembly

General Information and Principles of Operation



1. Height Control Valve
2. Adjustment Locknut
3. Overtravel Lever
4. Cotter Pin
5. Linkage Adjustment Clamp
6. Height Control Valve Linkage Rod
7. L-Rod
8. Height Control Valve Linkage Bracket

Fig. 2, Height Control Valve Assembly

General Guidelines

1. To keep the air suspension system operating reliably, the air system must be kept free of any oil, moisture, or foreign material. Inspect and maintain the air system components regularly. Refer to the applicable group of the vehicle maintenance manual for maintenance operations.

⚠ CAUTION

CAUTION: Failure to take precautions against the entry of moisture, oil, or other foreign material into the air suspension system could eventually lead to sludge forming in the air system. Sludge could adversely affect the operation of the air suspension system and other air system components.

2. Use only SAE grade 8 bolts, grade C prevailing torque locknuts, and hardened washers to attach spring hangers and brackets to the frame.
3. For suspension component inspecting, lubricating, and fastener torque checking intervals and instructions, refer to the maintenance schedule and the suspension group in the vehicle maintenance manual.

Height Control Valve Adjustment

General Information

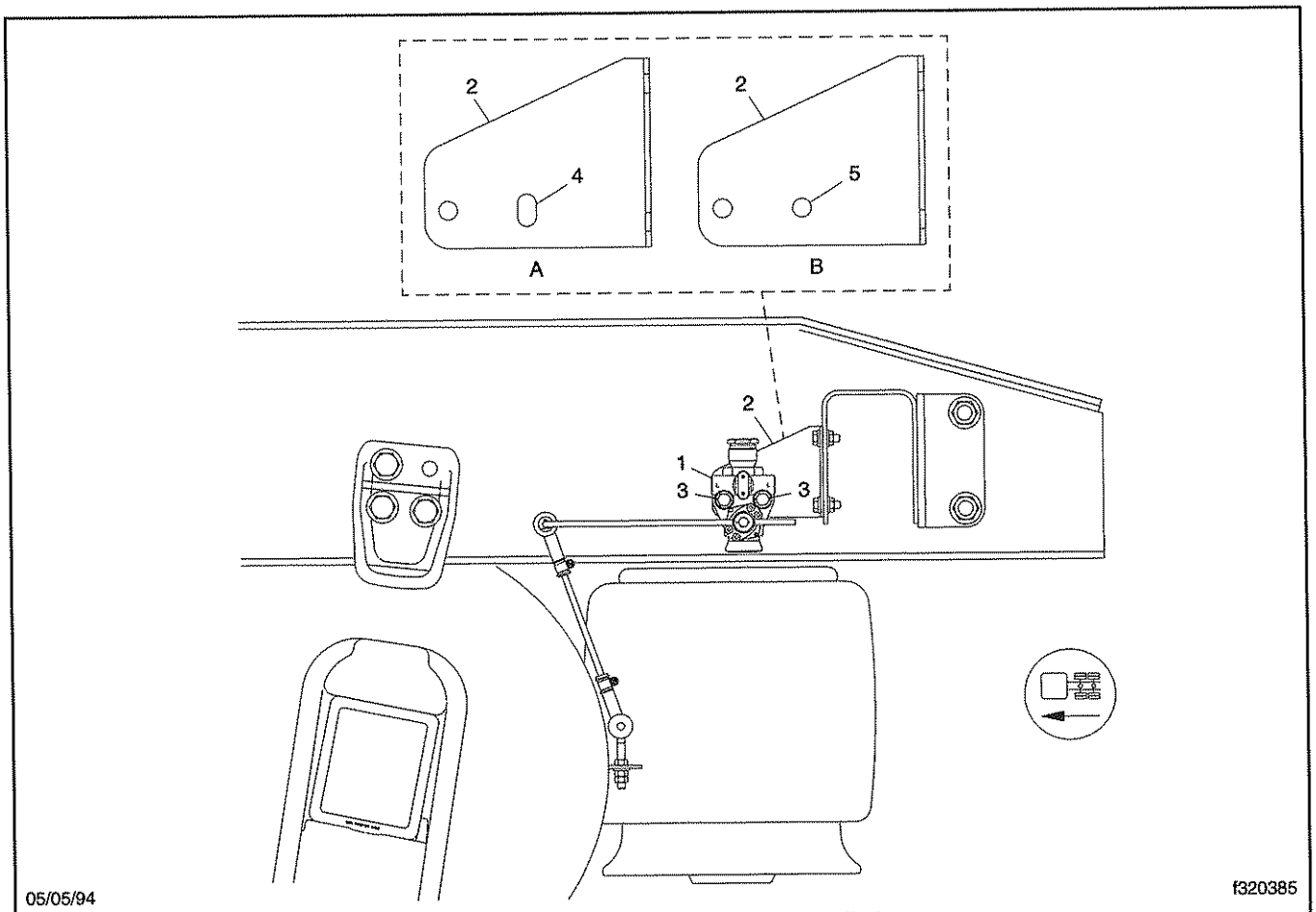
Adjust the height control valve with the vehicle on a level surface.

NOTE: A new type of height control valve (manufactured by Barksdale Inc.) replaced the Meritor WABCO valve. On vehicles with tandem-axle AirLiner rear suspensions, the Barksdale valve linkage rod is attached to the forward drive axle instead of the rearmost drive axle, and the valve is mounted on the frame rail. The Barksdale valves are installed on Business Class vehicles built after July 25, 1997.

⚠ CAUTION

Failure to adjust the height control valve could adversely affect driveline angles. Also, if the air springs are set too high, the driver may have difficulty (or be prevented from) backing the vehicle under a trailer. If the air springs are set too low, rapid wear of suspension parts will result.

There are two types of height control valve installations: adjustable and fixed. See **Fig. 1.**



A. Adjustable Installation
B. Fixed Installation
1. Height Control Valve
2. Mounting Bracket
3. Height Control Valve Mounting Fasteners
4. Slotted Hole
5. Round Hole

Fig. 1, Meritor WABCO Height Control Valve Installation

Height Control Valve Adjustment

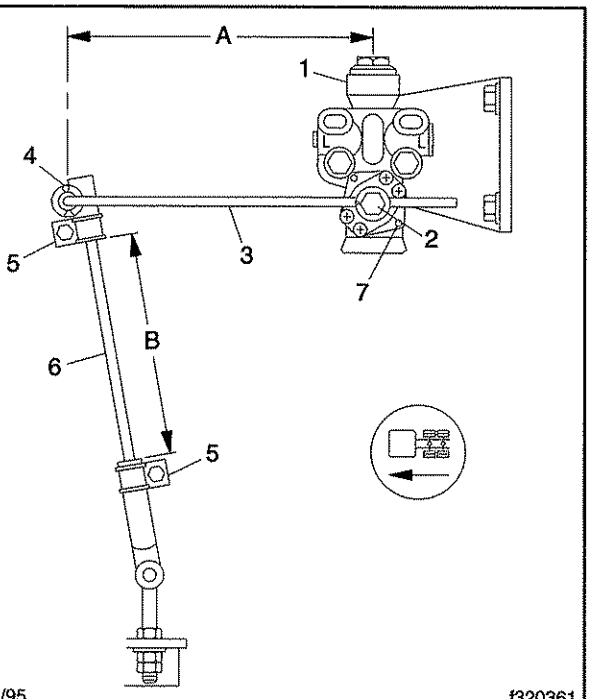
On adjustable installations, the suspension height is changed by tilting the height control valve up or down. On fixed installations, the height is changed by adjusting the length of the vertical linkage. Use the applicable procedure below to adjust the suspension height.

Height Control Valve Adjustment, Vehicles Equipped with Meritor WABCO Adjustable Valves

IMPORTANT: Before checking the AirLiner suspension height, make sure there is no load on the chassis. For tractors, unhitch the trailer. Trucks are to be empty.

1. Park the vehicle on a level surface, using a light application of the brakes. Do not apply the parking brakes. Put the transmission in neutral. Build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine.
2. Mark the location of the front and rear tires on the floor; then chock the tires on one axle only.
3. Check the length of the overtravel lever between its pivot points. See **Fig. 2.** The length should be 8 inches (203 mm). If needed, adjust the length of the overtravel lever.
   - 3.1 Loosen the adjustment locknut on the control shaft.
   - 3.2 Move the overtravel lever fore or aft until the length between the pivot points is 8 inches (203 mm).
   - 3.3 Tighten the adjustment locknut 62 lbf·in (700 N·cm).
4. Measure the distance from the bottom of the left forwardmost axle stop to the top of the axle U-bolt pad. See **Fig. 3** or **Fig. 4.**

   The correct distances are listed in **Table 1**.



A. Measure the length of the overtravel lever between these two points.
B. Measure the length of the linkage rod between these two points.

1. Height Control Valve
2. Adjustment Locknut
3. Overtravel Lever
4. Cotter Pin
5. Adjustment Clamp
6. Linkage Rod
7. Valve Centering Hole

Fig. 2, Meritor WABCO Height Control Valve Overtravel Lever and Linkage Rod Measurement

Suspension Height Adjustment Distances (except 12/15k Airliner)			
Suspension Type	Distance in Inches (mm)		
	Minimum	Target	Maximum
20/40k AirLiner	2-3/8 (60)	2-5/8 (67)	2-7/8 (73)
23/46k AirLiner	2-3/4 (70)	3 (76)	3-1/4 (83)
Low/Mid-Ride Height AirLiner	2-1/4 (57)	2-1/2 (64)	2-3/4 (70)
10k AirLiner	2-1/8 (54)	2-1/4 (58)	2-5/8 (67)

Table 1, Suspension Height Adjustment Distances (except 12/15k Airliner)

Height Control Valve Adjustment

NOTE: AirLiner suspensions feature three types of axle seats:

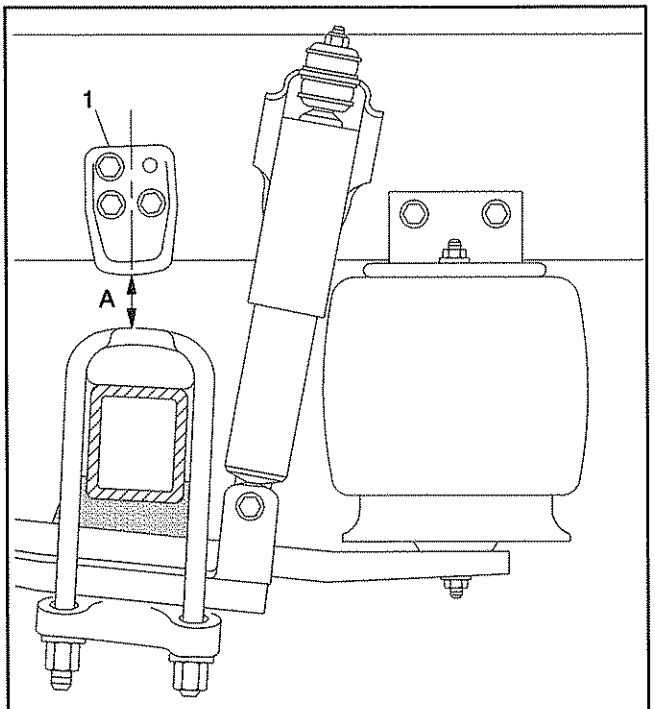
- a one-piece, cast axle seat, which is not welded to the axle housing;
- a one-piece, cast axle seat, which is welded to the axle housing;
- a two-piece, fabricated axle seat, which is welded to the axle housing.

Refer to **Fig. 5** to determine axle seat type.

5. If the distance is correct, nothing more needs to be done. Apply the parking brakes; then remove the chocks from the tires.

   If the distance isn't correct, go to the next step.

NOTE: If height adjustment is needed, use the target value for standard vehicles with one-piece axle seats, and subtract 1/4-inch (6 mm) from the target value for other vehicles.



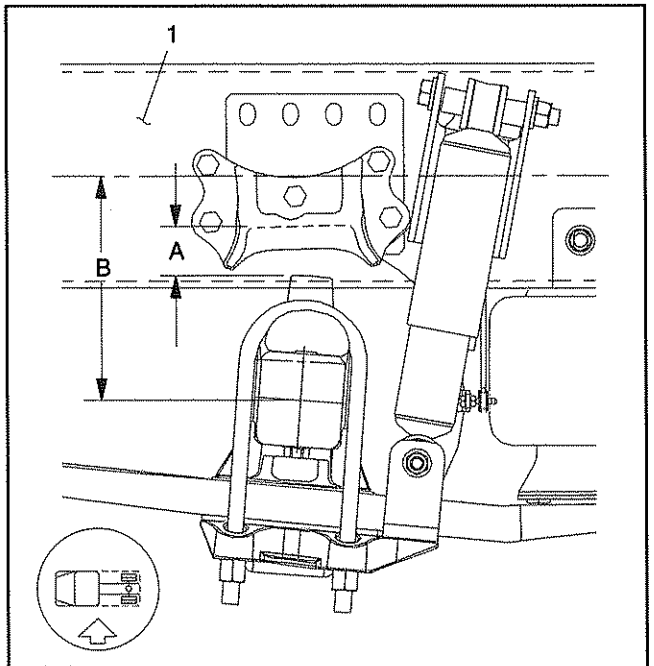
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A. Measure height here.
1. Left Forwardmost Axle Stop

Fig. 3, Axle Stop Measurement (old-style axle stop)

6. Loosen the two fasteners attaching the height control valve to the mounting bracket.
7. Rotate the height control valve clockwise (as you are facing it from the driver's side of the vehicle). Let the air exhaust from the valve until the distance from the bottom of the left forwardmost axle stop to the top of the axle U-bolt pad is 2 inches (51 mm) or less.
8. Rotate the height control valve counterclockwise, and raise the suspension height to the target value. Stop the air flow to the air bag by rotating the height control valve clockwise.
9. Center the height control valve.

   9.1 Rotate the valve very slightly clockwise and counterclockwise until you can insert a 4 mm pin into the valve centering hole. Don't rotate the valve too much, or you will change the suspension height.

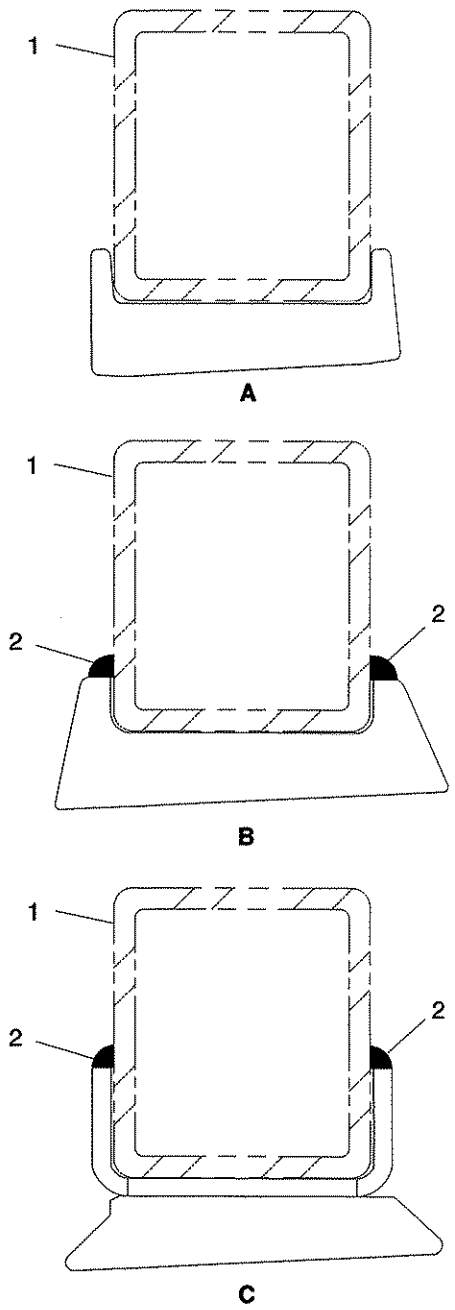


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A. Measure here.
B. Distance from Axle Centerline to Center of Frame Rail Web
1. Frame Rail

Fig. 4, Axle Stop Measurement (new-style axle stop)

Height Control Valve Adjustment



A. One-Piece Cast Axle Seat
B. One-Piece Cast Axle Seat
C. Two-Piece Fabricated Axle Seat
1. Axle Housing 2. Welds

Fig. 5, Axle Seats

9.2 Tighten the height control valve mounting fasteners firmly.

10. Drive the vehicle unloaded for about 1/4 mile (1/2 km); then stop the vehicle in the exact location (as previously marked) of the original measurement.

    Park the vehicle using a light brake application. Chock the tires on one axle only, and put the transmission in neutral. Do not apply the parking brakes.

11. Check the adjusted distance between the bottom of the left forwardmost axle stop and the top of the axle U-bolt pad. See **Fig. 3**.

12. If the distance isn't right, repeat the adjustment procedure.

13. Apply the parking brakes; then remove the chocks from the tires.

Height Control Valve Adjustment, Vehicles Equipped with Meritor WABCO Fixed Valves

IMPORTANT: Before checking the AirLiner suspension height, make sure there is no load on the chassis. For tractors, unhitch the trailer. Trucks are to be empty. In order to adjust the suspension height, you must change the length of the linkage rod using the following procedure. The previous method of centering the control valve and then adjusting the linkage no longer applies.

1. Park the vehicle on a level surface, using a light application of the brakes. Do not apply the parking brakes. Put the transmission in neutral. Build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine.

2. Mark the location of the front and rear tires on the floor; then chock the tires on one axle only.

3. Check the length of the suspension overtravel lever (see **Fig. 2**) to be consistant with adjusting the adjustable height control valve between its pivot points.

    If the length is acceptable, go to the step for measuring the suspension height.

    If the length is not acceptable, go to the next step.

4. Adjust the length of the overtravel lever.

4.1 Loosen the adjustment locknut on the control shaft. See **Fig. 2.**

4.2 Move the overtravel lever fore or aft until it is the correct length. See **Table 2** for the correct length.

Overtravel Lever Lengths	
Axle Designation	**Overtravel Lever Length In Inches (mm)**
Meritor RS23–161	8 (203)
Meritor 23–180	7-3/8 (187)
Eaton 23105 SC	7-1/4 (184)
Meritor SQ100	9-1/4 (235)
Meritor SSHD	9 (229)
Meritor RT40–145	9-3/4 (248)
Meritor RT44–145	9-3/4 (248)
Meritor RT46–160	8-1/8 (206)
Eaton 402	8-3/8 (213)
Eaton 404	8-3/8 (213)
Eaton 461	8-3/8 (213)

Table 2, Overtravel Lever Lengths

4.3 Tighten the adjustment locknut 62 lbf·in (700 N·cm).

5. Measure the distance from the bottom of the left forwardmost axle stop to the top of the axle U-bolt pad. See **Fig. 3** or **Fig. 4.** The correct distance is listed in **Table 2.**

   If the distance is correct, nothing more needs to be done. Apply the parking brakes, then remove the chocks from the tires.

   If the distance isn't correct, go to the next step.

NOTE: If height adjustment is needed, use the target value for standard vehicles with one-piece axle seats and subtract 1/4-inch (6 mm) from the target value for all other vehicles.

6. Determine how much the suspension height needs to be adjusted so the distance is correct. Then, using **Table 3,** find the amount the length of the linkage rod needs to be changed. See **Fig. 2.**

Vertical Linkage Lengths	
Suspension Height Change In Inches (mm)	**Vertical Linkage Length Change In Inches (mm)**
1/16 (2)	1/16 (2)
1/8 (3)	3/16 (5)
3/16 (5)	1/4 (6)
1/4 (6)	5/16 (8)
5/16 (8)	3/8 (10)
3/8 (10)	1/2 (13)
7/16 (11)	9/16 (14)
1/2 (13)	5/8 (16)
9/16 (14)	3/4 (19)
5/8 (16)	13/16 (21)
11/16 (17)	7/8 (22)
3/4 (19)	1 (25)
13/16 (21)	1-1/16 (27)
7/8 (22)	1-3/16 (30)
15/16 (24)	1-1/4 (32)
1 (25)	1-5/16 (33)

Table 3, Vertical Linkage Lengths

7. Adjust the length of the linkage rod as needed, adding or subtracting the amount shown in **Table 4.**

   NOTE: If the linkage rod is too short, replace it with a new rod, part number 16–13485–000. The linkage rod should be long enough so that at least 1/2 inch (13 mm) of it fits into both flexible end-sections of the linkage.

   7.1 Mark the existing length of the linkage rod between the upper and lower flexible end-sections of the linkage. See **Fig. 2.**

   7.2 Loosen both linkage adjustment clamps.

   7.3 Slide the flexible end-sections of the linkage over the linkage rod until the rod is the correct length.

   To increase the suspension height, lengthen the linkage rod; to decrease the suspension height, shorten the rod.

   7.4 Tighten the adjustment clamps.

Height Control Valve Adjustment

8. Drive the vehicle unloaded for about 1/4 mile (1/2 km); then stop the vehicle in the exact location (as previously marked) of the original measurement.

   Park the vehicle using a light brake application. Chock the tires on one axle only, and put the transmission in neutral. Don't apply the parking brakes.

9. Again, check the distance between the bottom of the left forwardmost axle stop and the top of the axle U-bolt pad.

10. If the distance isn't right, repeat the adjustment procedure.

11. Apply the parking brakes; then remove the chocks from the tires.

Height Control Adjustment, Vehicles Equipped With Barksdale Valves

1. Park the vehicle on a level surface, using a light application of the brakes. Do not apply the parking brakes. Put the transmission in neutral. Build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine.

2. Mark the location of the front and rear tires on the floor; then chock the tires on one axle only.

NOTE: The stud bolt fastening the lever arm to the linkage rod is installed correctly on AirLiner suspensions with Eaton 404 or Meritor RT40–145 axles when the threaded end of the stud bolt points toward the front of the vehicle. On AirLiner suspensions with Eaton 461 or Meritor RT46–160 axles, the threaded end of the stud bolt points to the rear of the vehicle. See **Fig. 6**.

3. Measure the suspensions height. See **Fig. 7**, **Fig. 8**, **Fig. 9**, or **Fig. 10**.

   See **Table 1** or **Table 4** for the correct distances.

   For 20k, 23k, and 40k double-leaf AirLiner suspensions, measure the distance between the top of the U-bolt and the bottom of the axle stop.

   For 10k, 12k, 15k , and 40k single-leaf Airliner suspensions, measure the distance between the top of the U-bolt pad and the bottom surface of the axle stop.

   If the measurement is acceptable, no more work is necessary.

   If the measurement is not acceptable, go to the next step.

IMPORTANT: Before checking the suspension height, make sure there is no load on the chassis. For tractors, unhitch the trailer. Trucks must be empty.

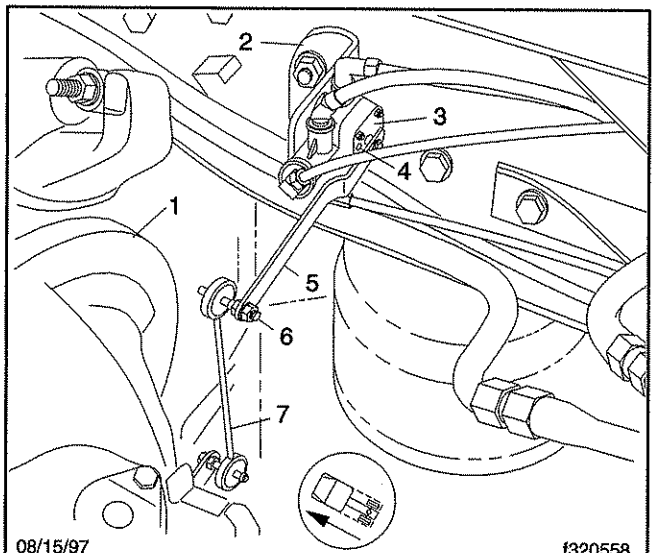
4. Adjust the suspension height. See **Table 1** or **Table 4** and for the correct distances.

   4.1 Loosen the two fasteners attaching the valve to the valve mounting bracket.

   4.2 Adjust the position of the valve body until the distance from the bottom of the left forwardmost axle stop to the top of the U-bolt is correct.

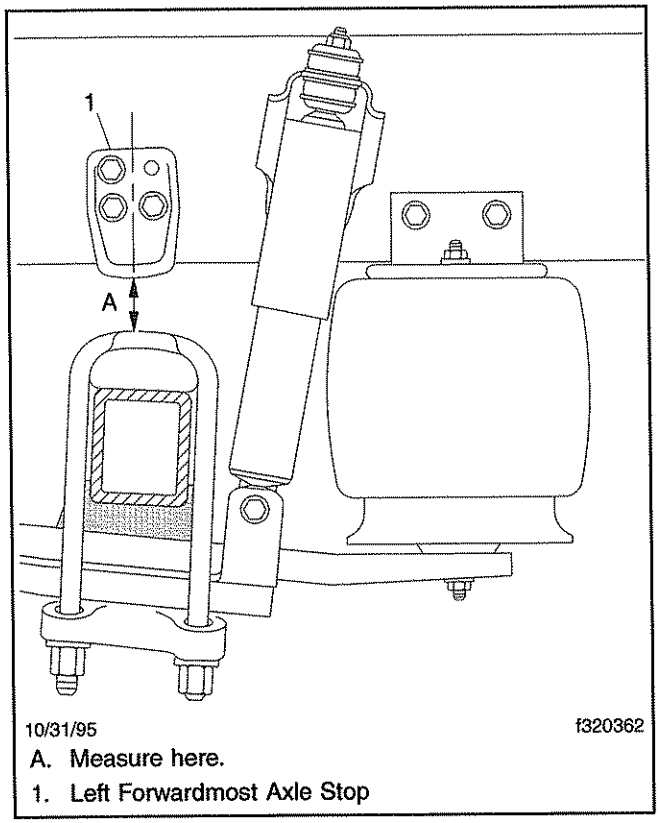
   4.3 Center the lever arm on the valve by inserting a 0.171-inch (4.4-mm) pin into the hole in the lever arm and aligning the hole with the valve body.

   4.4 Tighten the two fasteners attaching the valve to the mounting bracket.



1. Forward Drive Axle
2. Valve Mounting Bracket
3. Height Control Valve
4. Pilot Hole
5. Lever Rod
6. Stud Bolt
7. Linkage Rod

Fig. 6, Barksdale Height Control Valve Installation (Eaton 461/Meritor RT46-160 axle shown)



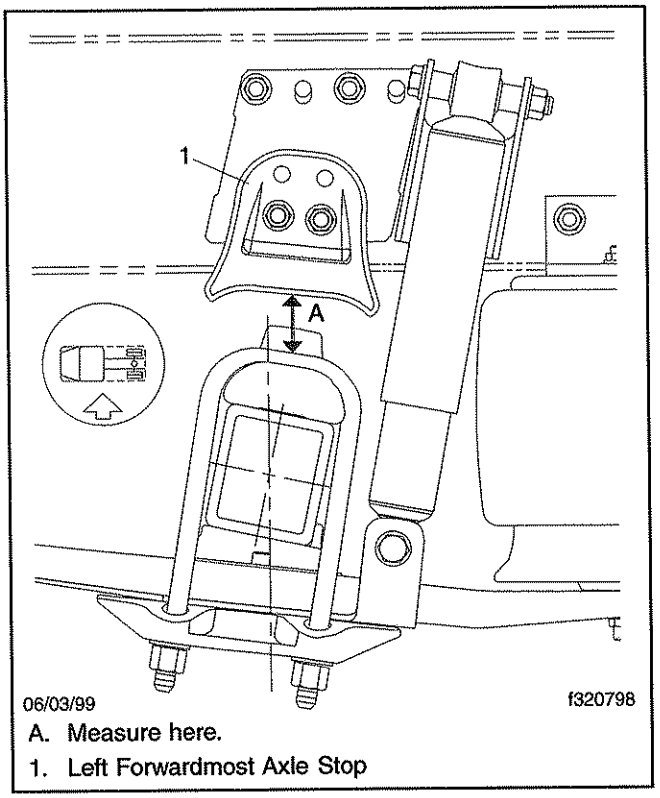
A. Measure here.
1. Left Forwardmost Axle Stop

Fig. 7, Barksdale Height Control Valve Adjustment Measurement (20k, 40k double-leaf, and 23/46k AirLiner shown)

4.5 Remove the pin from the hole in the lever arm.

5. Drive the vehicle unloaded for about 1/4 mile (1/2 km); then, stop the vehicle in the exact location (as previously marked) of the original measurement.

   Park the vehicle using a light brake application. Chock the tires on one axle only, and put the transmission in neutral. Do not apply the parking brakes.



A. Measure here.
1. Left Forwardmost Axle Stop

Fig. 8, Barksdale Height Control Valve Adjustment Measurement (40k single-leaf AirLiner)

6. *For 20k, 23k, and 40k double-leaf AirLiner suspensions,* measure the distance between the top of the U-bolt and the bottom of the axle stop.

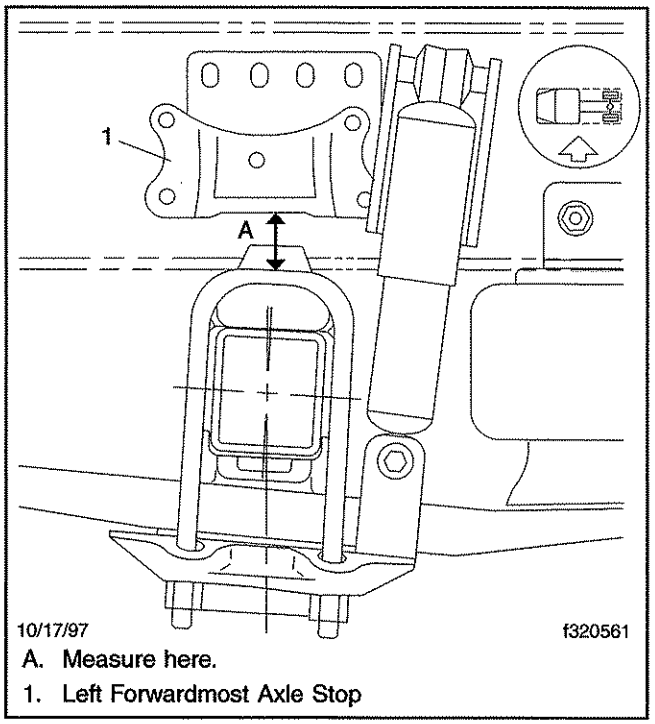
   For 10k, 12k, 15k, and 40k single-leaf Airliner suspensions, measure the distance between the top of the U-bolt pad and the bottom surface of the axle stop.

7. If the distance is not correct, repeat the adjustment procedure.

Suspension Height Adjustment Distances (AirLiner 12k, 15k, and 40k single-leaf only)			
Dimension "B" (see Fig. 10)	Distance in Inches (mm)		
	Minimum	Target	Maximum
10-1/4 Inches (260 mm)	2-1/8 (54)	2-1/4 (58)	2-5/8 (67)
11-1/4 Inches (285 mm)	2-3/8 (60)	2-1/2 (64)	2-7/8 (73)

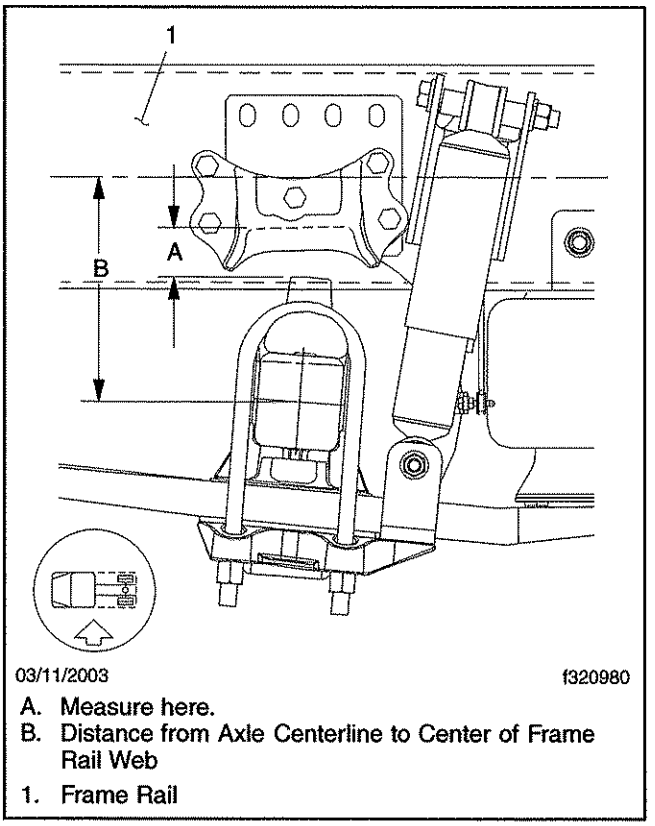
Table 4, Suspension Height Adjustment Distances (AirLiner 12k, 15k, and 40k single-leaf only)

Height Control Valve Adjustment



A. Measure here.
1. Left Forwardmost Axle Stop

Fig. 9, Barksdale Height Control Valve Adjustment Measurement (Low/Mid-Ride Height AirLiner shown)



A. Measure here.
B. Distance from Axle Centerline to Center of Frame Rail Web
1. Frame Rail

Fig. 10, Height Control Valve Measurement (10k, 12k, 15k, and 40k single-leaf suspensions)

Checking

The leveling valve is the control center of any air suspension system and responds to changes in height. When correctly adjusted, it maintains the correct suspension ride height.

Carefully check the valve before replacing it. Do the following steps to see if a valve is working correctly.

1. Disconnect the leveling valve linkage from the overtravel lever. **Refer to Fig. 1.**
2. Pull the overtravel lever up about 45 degrees. **See Fig. 2**, Ref. A. If air passes through the valve, that section of the valve is working.
3. Return the valve to the neutral position. **See Fig. 2**, Ref. B. Air should stop flowing. If so, that section of the valve is working.
4. Push the overtravel lever down about 45 degrees. **See Fig. 2**, Ref. C. If air exhausts from the valve, that section of the valve is working.
5. Return the valve to the neutral position. If the air stops again in the neutral position, the valve is working correctly.
6. If the valve works as stated in all of the above steps, then no further checking is necessary. Connect the leveling valve linkage to the overtravel lever. Secure the linkage with a cotter pin.

   If the valve needs adjusting, refer to **"Leveling Valve Adjustment, 110."** If the valve needs replacing, refer to **"Leveling Valve Replacement, 130."**

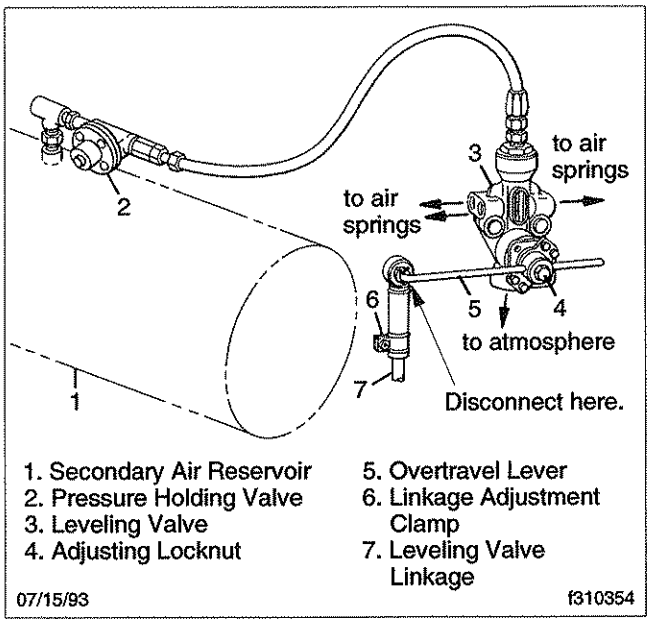


Fig. 1

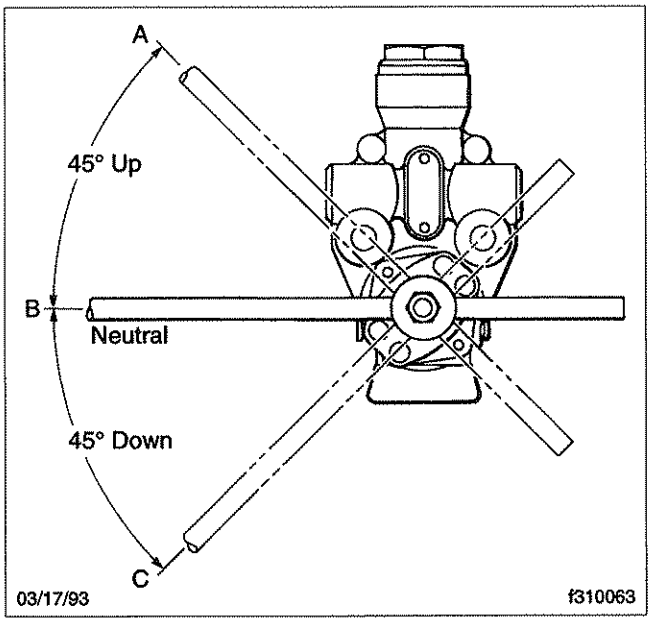


Fig. 2

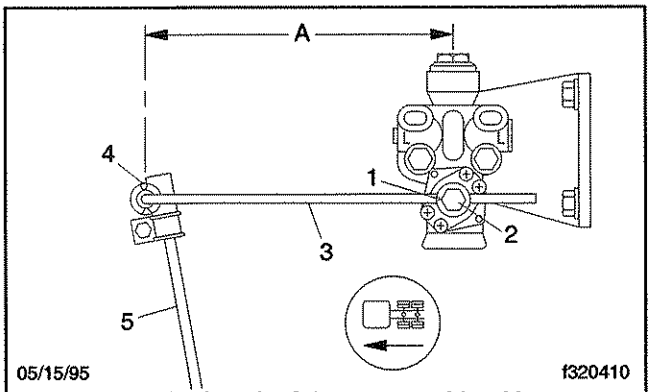
Height Control Valve Replacement

Replacement

NOTE: A new type of height control valve (manufactured by Barksdale Inc.) replaced the Meritor WABCO valve. On vehicles with tandem-axle AirLiner rear suspensions, the Barksdale valve linkage rod is attached to the forward drive axle instead of the rearmost drive axle, and the valve is mounted on the frame rail. The Barksdale valves are installed on Business Class vehicles built after July 25, 1997.

Meritor WABCO

1. Park the vehicle on a level surface. Shut down the engine and apply the parking brake. Chock the front tires.
2. Drain the air reservoirs.
3. Disconnect the linkage from the overtravel lever. See **Fig. 1**. Exhaust all air from the air springs by moving the overtravel lever down.
4. Disconnect the air lines at the height control valve, and mark the lines for later reference. Using tape, cover the open ends of the air lines and fittings to prevent dirt or foreign material from entering.
5. Remove the height control valve mounting bolts and nuts, and remove the height control valve from the bracket.



A. Measure the length of the overtravel level between these two points.
1. V-Shaped Mark
2. Adjustment Locknut
3. Overtravel Lever
4. Cotter Pin
5. Linkage Rod

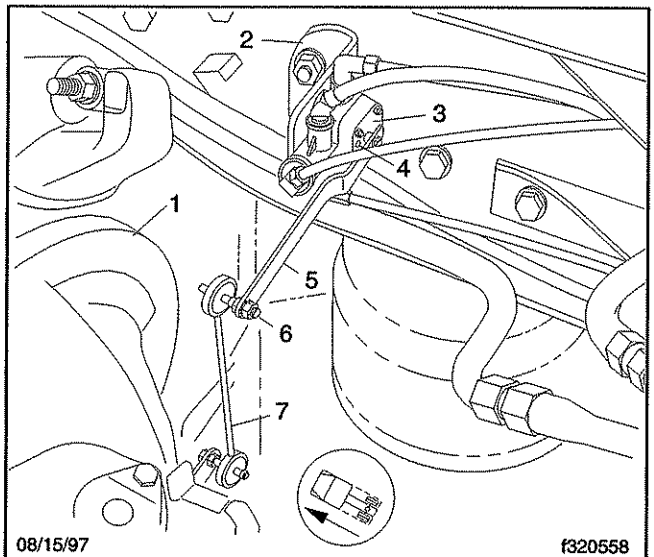
Fig. 1, Meritor Height Control Valve Linkage Measurement

6. Remove the overtravel lever from the height control valve.
7. Attach the new height control valve to the bracket. Tighten the valve mounting bolt nuts 14 lbf·ft (19 N·m).
8. Remove the tape from the air lines and fittings, and connect the air lines to the height control valve as marked earlier. Tighten nylon tube air fittings until only two threads show on the fitting. On wire-braid hose fittings, tighten the nut with a wrench until there is firm resistance, then tighten one-sixth turn more.
9. Connect the height control valve linkage to the overtravel lever. Secure the linkage with a cotter pin.
10. Connect the overtravel lever to the height control valve. Insert the overtravel lever into the valve at the hole with the V-shaped mark. See **Fig. 1**. Be sure the length between pivot points is 8 inches (20.3 cm). See **Fig. 1**, Ref. A.
11. Close the drain cocks on all reservoirs.
12. Build up normal operating pressure in the air system. Check all air lines and connections for leaks. Eliminate all leaks.
13. Remove the chocks from the tires.
14. Adjust the height control valve. For instructions, see **Subject 110**.

Barksdale Inc.

1. Park the vehicle on a level surface. Shut down the engine and apply the parking brake. Chock the front tires.
2. Drain the air reservoirs.
3. Disconnect the linkage from the overtravel lever. See **Fig. 2**. Exhaust all air from the air springs by moving the overtravel lever down.
4. Disconnect the air lines at the height control valve, and mark the lines for later reference. Using tape, cover the open ends of the air lines and fittings to prevent dirt or foreign material from entering.
5. Remove the height control valve mounting bolts and nuts, and remove the height control valve from the bracket.

Height Control Valve Replacement



1. Forward Drive Axle
2. Valve Mounting Bracket
3. Height Control Valve
4. Pilot Hole
5. Overtravel Lever
6. Stud Bolt
7. Linkage Rod

Fig. 2, Barksdale Height Control Valve Installation

6. Attach the new height control valve to the bracket. Tighten the valve mounting bolt nuts 14 lbf·ft (19 N·m).
7. Remove the tape from the air lines and fittings, and connect the air lines to the height control valve as marked earlier. Tighten nylon tube air fittings until only two threads show on the fitting. On wire-braid hose fittings, tighten the nut with a wrench until there is firm resistance, then tighten one-sixth turn more.
8. Connect the height control valve linkage to the overtravel lever.
9. Close the drain cocks on all reservoirs.
10. Build up normal operating pressure in the air system. Check all air lines and connections for leaks. Eliminate all leaks.
11. Remove the chocks from the tires.
12. Adjust the height control valve. For instructions, see **Subject 110**.

Shock Absorber Replacement

Replacement (See Fig. 1)

1. Chock the tires.
2. Remove the locknut, bolt, washers, and spacer from the shock absorber lower mounting bracket.
3. Remove the nut, upper retainer, and upper bushing from the top of the shock absorber.
4. Pull the shock absorber out of the upper mounting bracket, and remove the retainer and bushing.
5. Install the replacement shock absorber, making sure the new bushings and retainers are positioned as shown in **Fig. 2.**

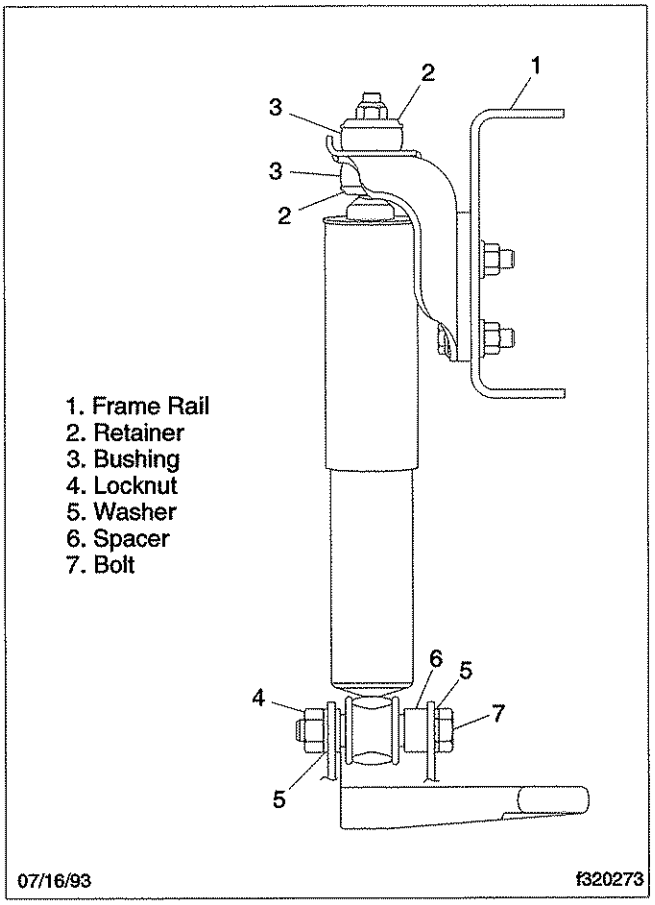


Fig. 1, Shock Absorber Mounting

⚠ WARNING

WARNING: Use only the retainers included with the replacement shock absorber. Do not use washers. They can be pushed over the nut and be ejected violently, possibly causing personal injury and property damage.

6. Tighten the shock absorber lower mounting locknut 230 N·m (170 lbf·ft).
7. Tighten the shock absorber upper mounting nut to compress the bushings to the dimension shown in **Fig. 2.**

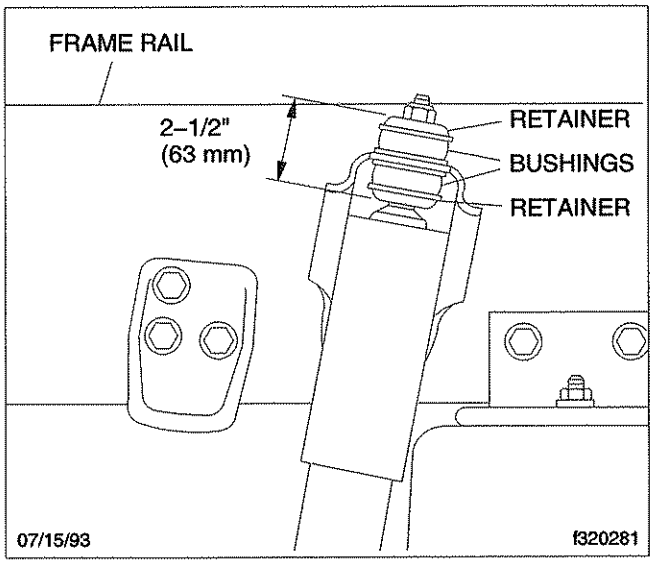


Fig. 2

Air Spring Bag Replacement

Replacement

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front tires. Raise the vehicle frame and support it with safety stands to remove all weight from the air springs.
2. Disconnect the leveling valve and exhaust all air from the air springs.
3. Using a dull instrument, pry the air spring bead off the piston lip. Be careful not to damage the piston.
4. Disconnect the air supply line, including the brass tee, from the air spring. Using tape, cover the ends of the air supply line and the fitting to prevent dirt or foreign material from entering.
5. Remove the locknuts and washers that connect the air spring bag to the upper mounting bracket.
6. Remove the air spring bag.
7. Check the piston for residue, and remove any, if found.

NOTE: When space is limited (such as at the forward axle of tandem axles), it may be easier to remove the piston from the leaf spring and assemble the bag and piston on a workbench. Secure the air spring mounting bracket, which is attached to the bag, in a vise. Fully extend the air bag and plug the air supply port. Apply a soap-and-water solution to the piston lip and air bag bead, and, using a twisting motion, push the piston onto the airbag until the piston is fully seated. Inspect the circumference of the bag-to-piston connection to make sure there is less than 1/8 inch (3.2 mm) of clearance between the air bag and the piston shoulder. The gap should be uniform around the assembly. After inspecting, remove the plug in the air supply port and push the piston into the air bag so that it rolls over the piston. Then, install on the vehicle.

⚠ WARNING

Do not add air pressure to the air spring assembly when it is not mounted on a vehicle.Doing so could cause components to eject from the assembly, which could cause serious personal injury or property damage.

8. Attach the new air spring bag to the upper mounting bracket, using the 1/2–13 locknut on the outsideof the frame rail and the 3/4–16 locknut on the inside. Tighten 3/4–16 locknuts 61 N·m (45 lbf·ft);tighten 1/2–13 locknuts 31 N·m (23 lbf·ft).
9. Remove the tape from the ends of the air supply line, the fitting, and the brass tee. Connect the air supply line to the air spring. Tighten nylon tube air fittings until only two threads show on the fitting. Onwire-braid hose fittings, tighten the nut with a wrench until there is firm resistance, then tighten one-sixth turnmore.
10. Make sure the air spring bag is fully extended alongside the piston so there are no folds in thebag near the bead. See **Fig. 1.**
11. Fold the air spring bag so the bead is fully parallel with the piston lip. See**Fig. 2.**
12. Apply a soap-and-water solution to the bead and piston lip.
13. Pull the rear of the air spring bag over the piston lip making sure the bead is the lowest part of thebag— none of the bag should droop over the piston. Then, work the front of the bag over the piston lip like a button in a button hole. See **Fig. 3.**
14. Feeling the bead through the folds of the air spring bag, snap the bead over the piston lip so itseats fully. A snapping sound confirms correct seating of the bead.
15. Inspect the circumference of the bag-to-piston connection to make sure there is less than 1/8 inch (3.2 mm) of clearance between the air bag and the piston shoulder. The gap should be uniform around the assembly.
16. Connect the leveling valve and inflate the air spring bag. As it's inflating, the bag shouldroll into position over the piston. See **Fig. 4.**
17. Remove the safety stands, and lower the vehicle. Remove the chocks from the tires.

Air Spring Bag Replacement

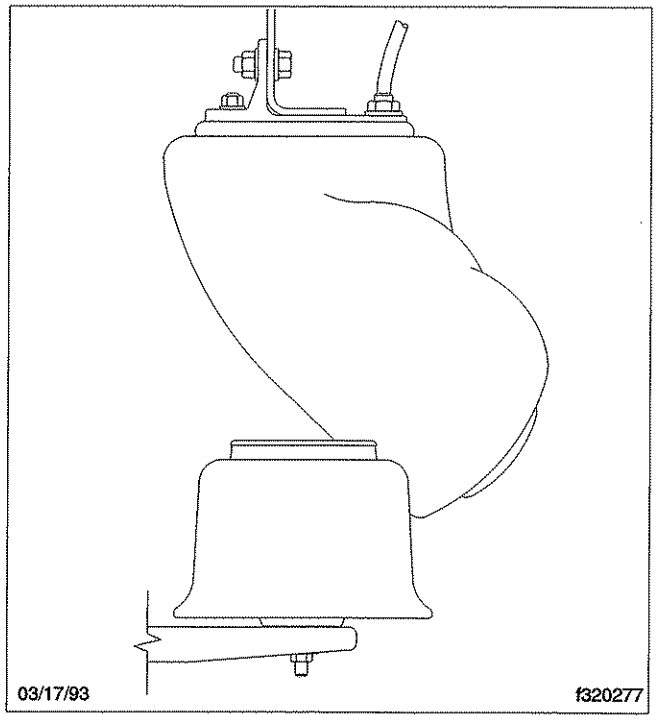


Fig. 1, Air Spring Bag Extended

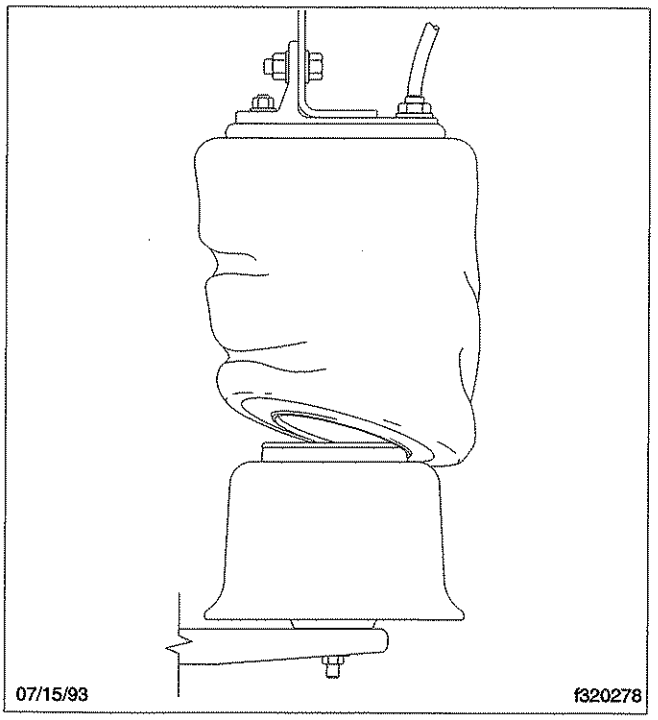


Fig. 3, Air Spring Bag Aligned with Piston

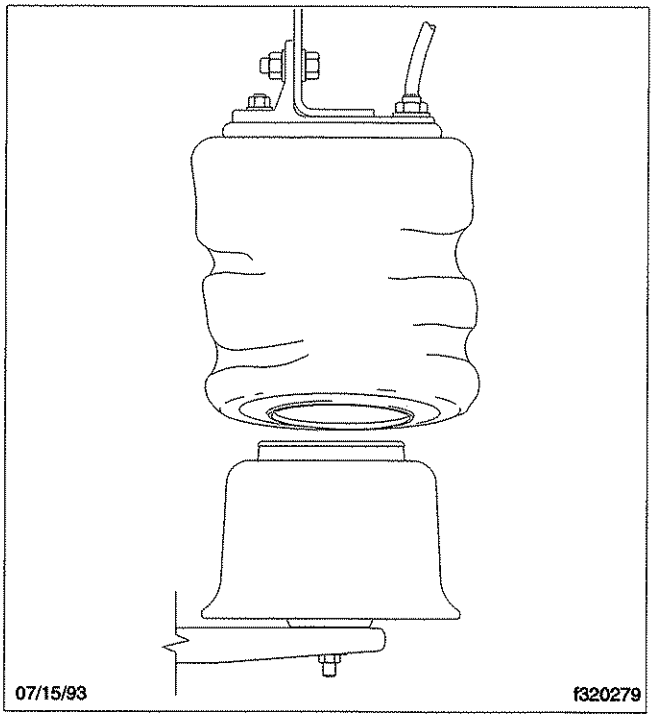


Fig. 2, Air Spring Bag Folded

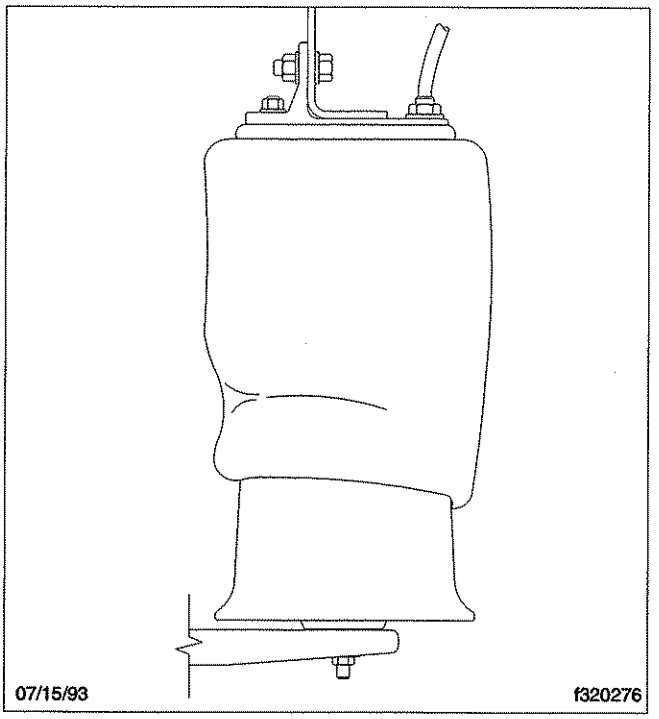
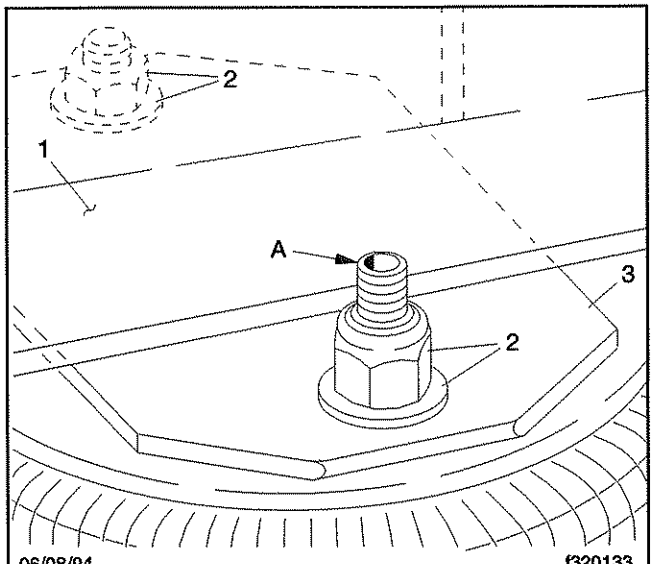


Fig. 4, Air Spring Bag Rolling Onto Piston

Air Spring Replacement

1. Chock the front tires. Raise the vehicle frame and support it with safety stands to remove all weight from the air springs. The leveling valve automatically releases air from the air springs when all weight is removed from the suspension.
2. Disconnect the air supply line,including the brass tee, from the air spring. Using tape, cover the ends of the air supply line and the fitting to prevent dirt or foreign material from entering.
3. Remove the locknuts and washers that connect the air spring to the upper mounting bracket, or to the frame rail flange. See **Fig. 1** and **Fig. 2.**
4. Remove the capscrews and lockwashers that connect the air spring to the rear of the leaf spring. Remove the air spring. **See Fig. 3.**

NOTE: Suspensions manufactured to a 46,000-pound (20 865 kg) or 23,000-pound (10 433 kg) weight rating have a different leaf spring, and an additional cross bar attached between the air spring and rear of the leaf spring. **See Fig. 4.**

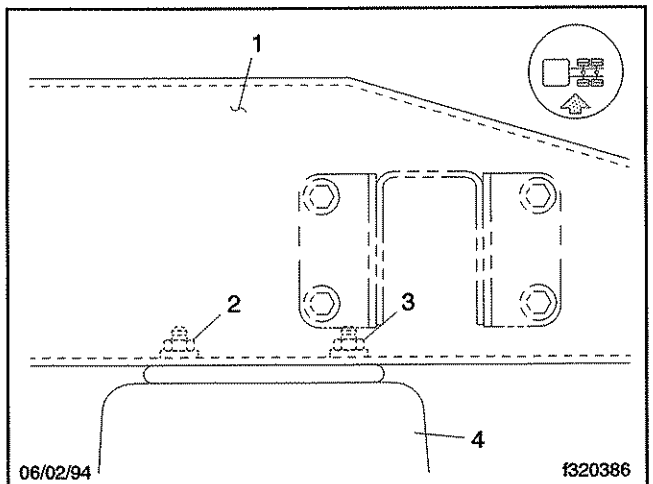


A. Air line connects here.
1. Right Frame Rail Flange
2. Locknut and Washer
3. Upper Mounting Bracket

Fig. 1, Bracket-Mounted Air Spring

5. Place the new air spring on the rear of the leaf spring (or the cross bar on the 23,000- and 46,000-pound suspensions), and install the washer and locknut that hold the air spring (and cross bar) in place. **See Fig. 3.** Tighten the locknut 55 lbf·ft (75 N·m).
6. *For bracket-mounted air springs:* Attach the air spring to the upper mounting bracket, using the 1/2–13 locknut on the outside of the frame rail and the 3/4–16 locknut on the inside. **See Fig. 1.** Tighten the 3/4–16 locknut 45 lbf·ft (61 N·m); tighten the 1/2–13 locknut 23 lbf·ft (31 N·m).

   For flange-mounted air springs: Attach the air spring to the frame rail flange, using the 3/4–16 locknut on the forward stud of the air spring, and the 1/2–13 locknut on the rear stud. **See Fig. 2.** Tighten the 3/4–16 locknut 45 lbf·ft (61 N·m); tighten the 1/2–13 locknut 23 lbf·ft (31 N·m).
7. Remove the tape from the ends of the air supply line, the fitting, and the brass tee. Connect the air supply line to the air spring. Tighten nylon tube air fittings until only two threads show on the fitting. On wire-braid hose fittings, tighten the nut with a wrench until there is firm resistance, then tighten one-sixth turn more.
8. Remove the safety stands, and lower the vehicle. Remove the chocks from the tires.



1. Frame Rail (left)
2. 3/4–16 Locknut and Washer
3. 1/2–13 Locknut and Washer
4. Air Spring

Fig. 2, Flange-Mounted Air Spring

Air Spring Replacement

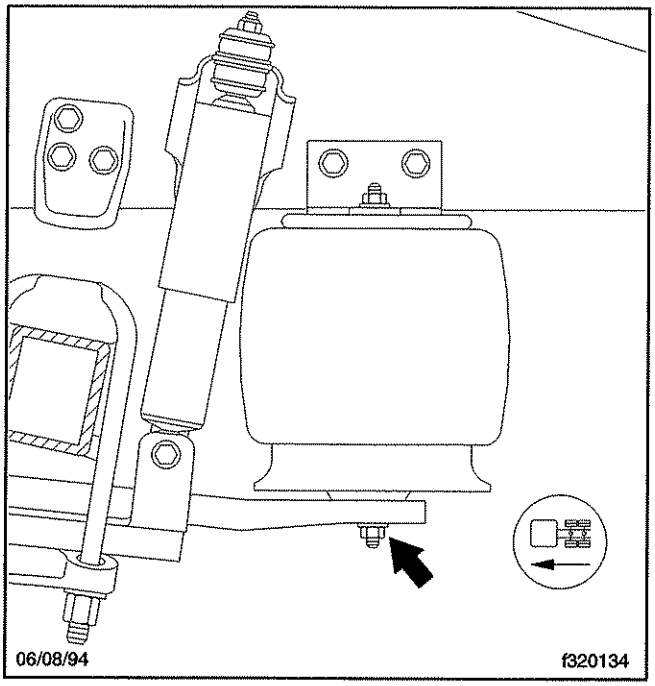
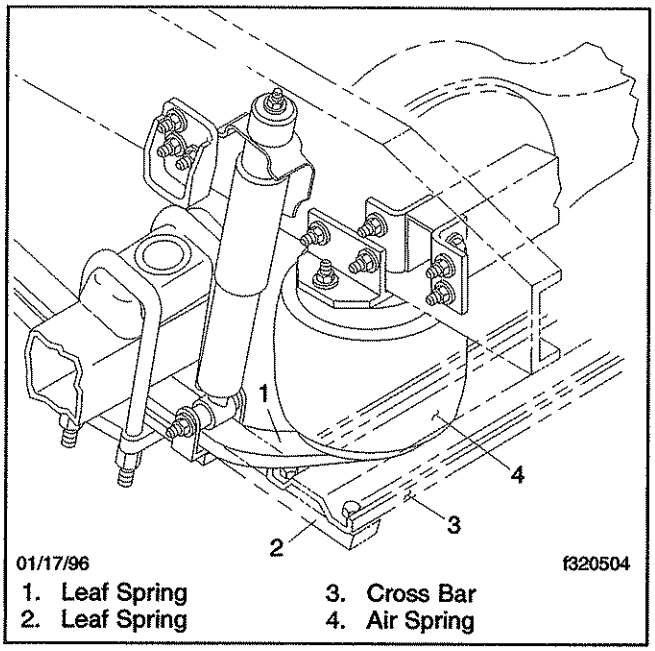


Fig. 3, Capscrew Connecting Leaf Spring and Air Spring



1. Leaf Spring
2. Leaf Spring
3. Cross Bar
4. Air Spring

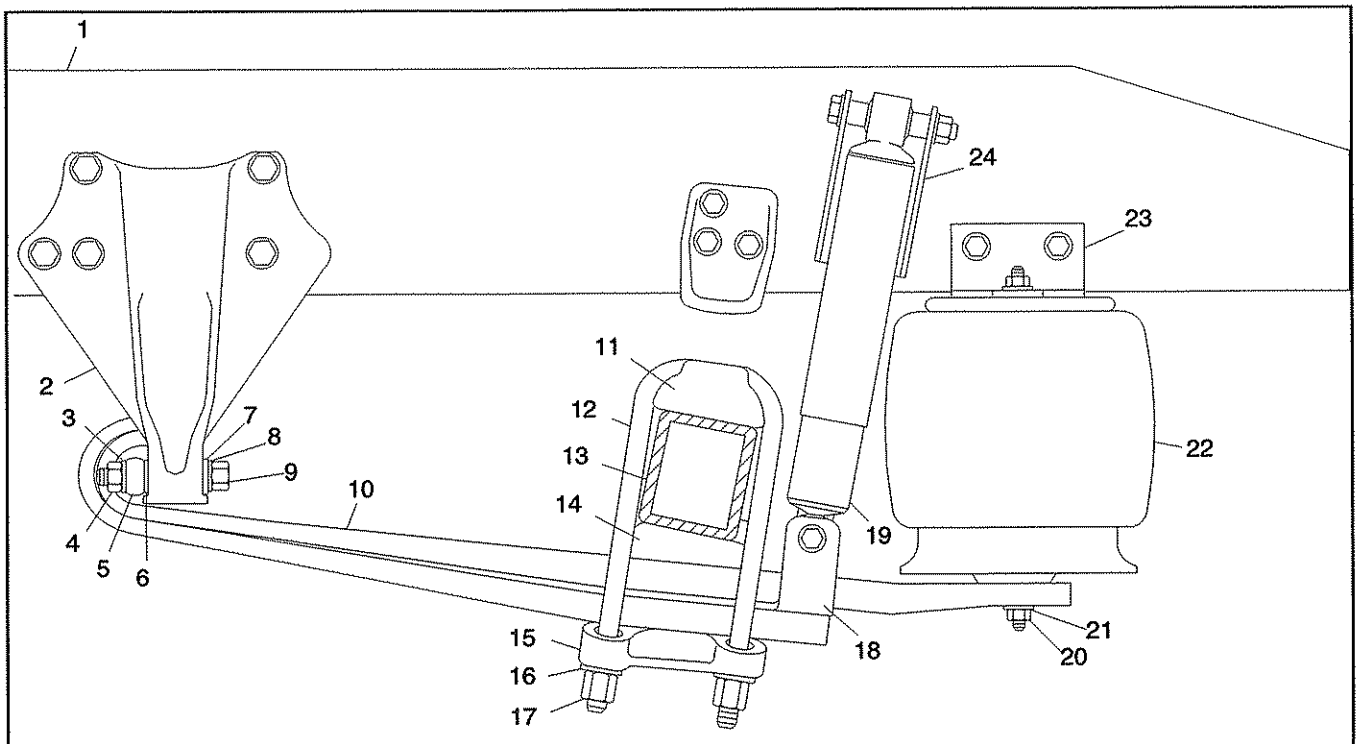
Fig. 4, Leaf Spring and Air Spring Assembly (23,000- and 46,000-pound suspensions)

Leaf Spring Replacement (See Fig. 1)

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

1. Chock the front tires.
2. Raise the rear of the vehicle, and support the rear axle(s) with safety stands. Raise the vehicle so that all weight is removed from the leaf springs, then securely support the frame with safety stands. Remove the wheel and tire assembly to easily access the suspension. Refer to the wheels and tires section in this manual for instructions.
3. Remove the nut, bolt, and washers from the shock absorber lower mounting bracket. Remove the high nuts, flatwashers, and axle clamp from each U-bolt. Support the leaf spring assembly with a jack.



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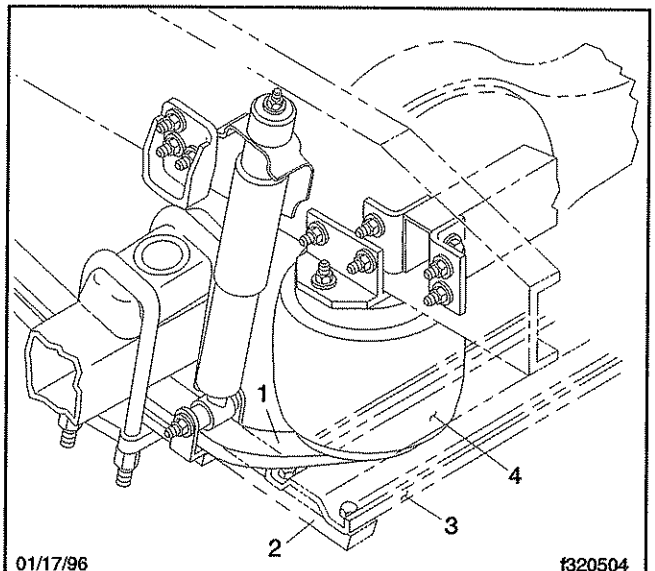
1. Frame Rail
2. Spring Hanger
3. Washer
4. Hexnut
5. Spring Mounting Eye Pin
6. Alignment Shim
7. Wear Shoe Clip
8. Washer
9. Spring Mounting Bolt
10. Leaf Spring Assembly
11. U-Bolt Pad
12. U-Bolt
13. Axle
14. Axle Seat
15. Axle Clamp
16. Flatwasher
17. High Nut
18. Shock Absorber Lower Mounting Bracket
19. Shock Absorber
20. Nylon Locknut
21. Washer
22. Air Spring
23. Air Spring Mounting Bracket
24. Shock Absorber Upper Mounting Bracket

Fig. 1, AirLiner Leaf Spring Assembly

Leaf Spring Replacement

4. If the air spring mounts to the leaf spring, disconnect the bottom of the air spring from the leaf spring.

   If the air spring mounts to a cross bar, disconnect the cross bar from the leaf spring by removing the capscrews, nuts, and washers. See **Fig. 2**.



1. Leaf Spring
2. Leaf Spring
3. Cross Bar
4. Air Spring

Fig. 2, Leaf Spring and Air Spring Assembly (23,000- and 46,000-pound suspensions)

5. Note the number and position of the alignment shims (See **Fig. 1**) on the spring mounting bolt.
6. Remove the hexnut, washers, alignment shim(s), spring mounting bolt, and wear shoe clip from the spring hanger. See **Fig. 1**.

⚠ WARNING

The leaf spring assembly is heavy. Use care when handling it to prevent injury.

7. Remove and discard the leaf spring assembly.
8. While supporting a new leaf spring assembly with a jack, position the assembly on the spring hanger. Install the bolts, wear shoe clips, washers, alignment shims, and hexnuts. Tighten the bolts just enough to hold the leaf spring assembly in place.
9. If the air spring mounts to the leaf spring, attach the air spring to the leaf spring assembly. Install the washer and locknut. Tighten the locknut 55 lbf·ft (75 N·m).

   If the air spring mounts to a cross bar, attach the cross bar to the leaf spring assembly. The longer capscrews attach in the forwardmost holes; the shorter capscrews attach in the aft holes.
10. Making sure that the U-bolt pads are in place on the top of the axle, fasten the leaf spring assembly to the axle using the U-bolts, axle clamp, washers, and high nuts making sure the U-bolt pads and axle clamps are positioned correctly.

NOTE: On single-drive axles angled 5 degrees, the arrow on the U-bolt pads must point to the front of the axle housing. See **Fig. 3**. On single-drive axles angled 3 degrees, there is no arrow. Make sure that the axle bump stop on the U-bolt pad is positioned toward the vehicle centerline. See **Fig. 4**.

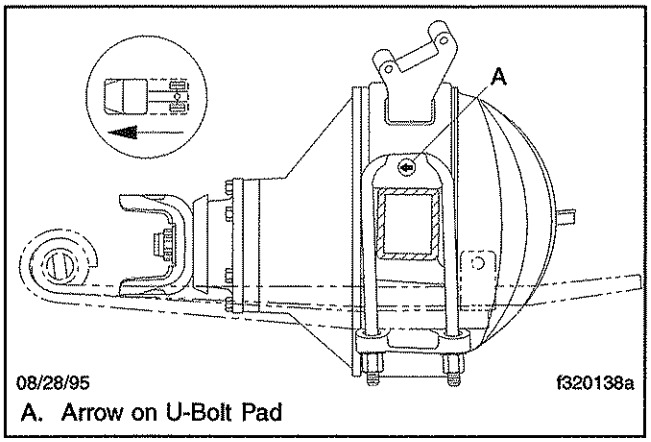
With both 5- and 3-degree single-drive axle angles, the arrow on the bottom of the axle clamp (see **Fig. 1**) must point toward the rear of the vehicle.

On tandem axle suspensions, refer to **Table 1** for U-bolt pad orientation. The arrow on the bottom of the axle clamp must point toward the rear of the vehicle on the forward rear axle and toward the front of the vehicle on the rearmost axle.

11. Tighten the U-bolt high nuts as described in **Specifications 400**.
12. Install the bolt, washers, and hexnut to connect the shock absorber to its lower mounting bracket. Tighten the hexnut 170 lbf·ft (230 N·m).
13. Tighten the locknut on the bottom of the air spring 55 lbf·ft (75 N·m).

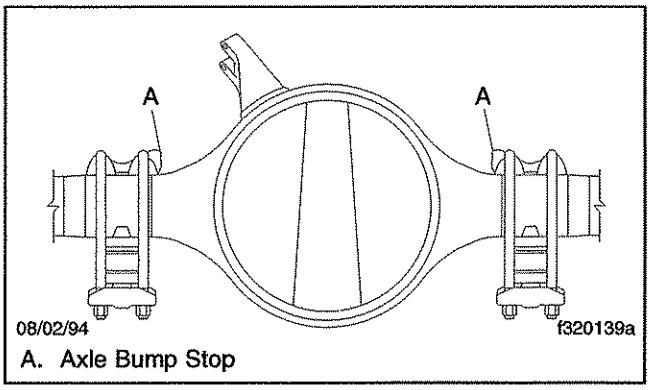
    On 23,000-pound and 46,000-pound suspensions, tighten the locknuts on the bottom of the cross bar 241 lbf·ft (327 N·m).
14. Tighten the hexnuts at the front of the leaf spring 170 lbf·ft (230 N·m).
15. Install the wheel and tire assembly. For instructions, refer to **Group 40**. Remove the safety stands, and lower the vehicle.
16. Check the rear axle alignment. For instructions, refer to the rear axle section in this manual. If

necessary, adjust the rear axle alignment using the instructions in **Subject 180.**



A. Arrow on U-Bolt Pad

Fig. 3, U-bolt Pad Arrow Positioning



A. Axle Bump Stop

Fig. 4, Axle Bump Stop Positioning

U-Bolt Pad Orientation for Axles		
Axle Designation		**U-Bolt Pad Orientation**
Meritor SQ 100, SSHD	Forward Rear Axle	No arrow; axle bump stop toward vehicle centerline.
	Rearmost Axle	No arrow; axle bump stop toward vehicle centerline.
Meritor RT40-145, RT44-145, RT46-160	Forward Rear Axle	No arrow; axle bump stop toward vehicle centerline.
	Rearmost Axle	Arrow toward front of vehicle.
Eaton 402, 461	Forward Rear Axle	No arrow; axle bump stop toward vehicle centerline.
	Rearmost Axle	No arrow; axle bump stop toward vehicle centerline.

Table 1, U-Bolt Pad Orientation for Axles

Spring Eye Bushing Replacement

Replacement

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

1. Park the vehicle on a level surface. Shut down the engine. Set the parking brake and chock the front tires.
2. Raise the rear of the vehicle, and support the rear axle(s) with safety stands. Raise the vehicle so that all weight is removed from the leaf springs, then securely support the frame with safety stands.
3. Remove the wheel and tire assembly to easily access the suspension. For instructions, see the information in **Group 40**.
4. Remove the leaf spring assembly. See removal information in **Subject 170**.

⚠ WARNING

The leaf spring assembly is heavy. Use care when handling it to prevent injury.

5. Remove the bushing from the leaf spring eye.

⚠ WARNING

Do not use a cutting torch to remove the outer metal of the bushing from the spring eye. Welding, torching or cutting the leaf spring assembly can damage the leaf spring material, which may result in the failure of the components and cause serious personal injury, death, or property damage.

   5.1 Using a shop press with a capacity of at least 10 tons (9 072 kg), place the spring assembly in the shop press with the spring assembly squarely supported on the press bed for safety and to avoid bending the spring assembly.

   5.2 Center the bushing tool on the outer metal of the bushing and push the bushing from the spring eye.

   5.3 Remove any burrs or material left behind by the old bushing.

6. Install the new bushing in the leaf spring eye.

   6.1 Position the bushing on the shop press.

   6.2 Apply a bonding agent, either Perma-bond HM–160 or Loctite RC–609 or 680, liberally around the outside surface of the bushing.

   6.3 Press the bushing into place.

   6.4 Allow the bonding agent to cure for 24 hours.

   NOTE: After the curing time, the bushing must resist a minimum 7,700 lb (3 490 kg) pushout force.

7. Install the leaf spring assembly. See the information in **Subject 170**.
8. Install the wheel and tire assembly. For instructions, see **Group 40**. Remove the safety stands, and lower the vehicle.
9. Check the rear axle alignment. For instructions, refer to **Group 35** in this manual. If necessary, adjust the rear axle alignment using the instructions in **Group 35**.
10. Remove the chocks from the tires.

Adjusting

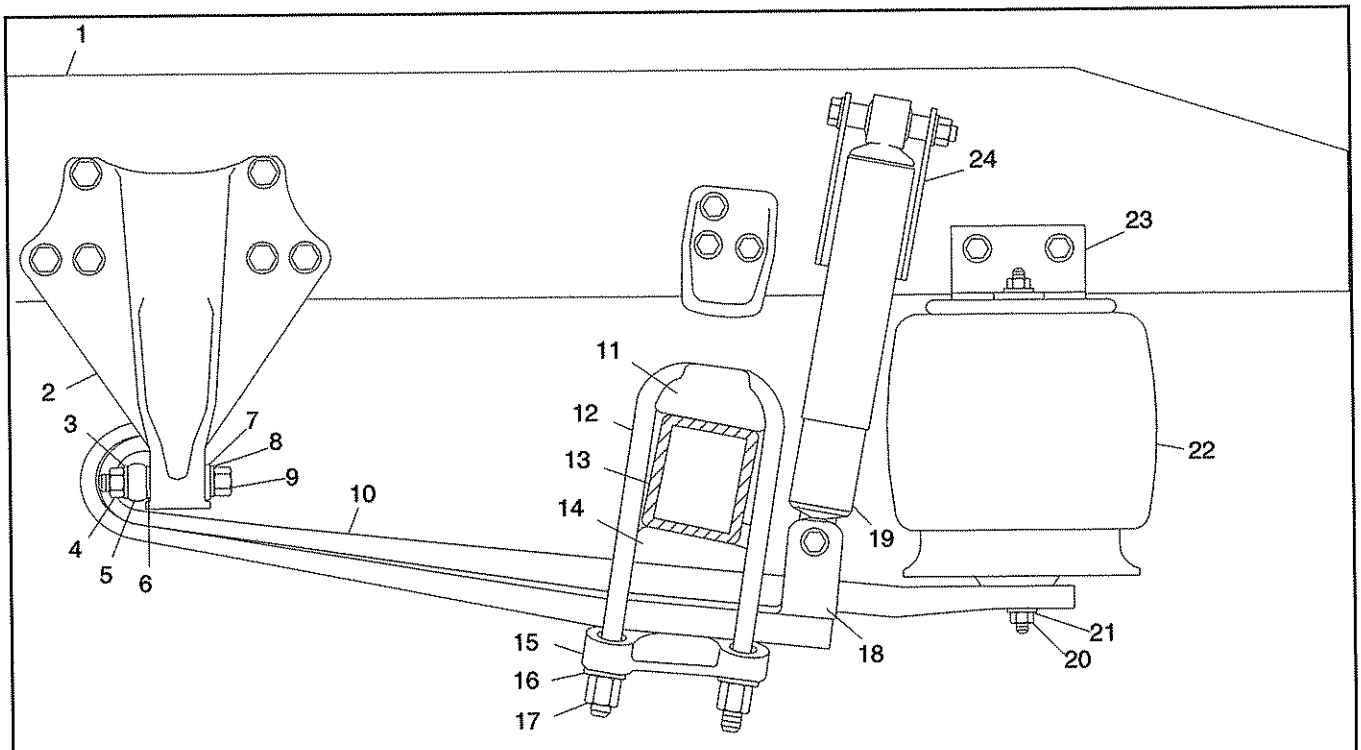
See **Fig. 1**.

Follow the instructions in the rear axle alignment checking section of this manual to see if rear axle alignment adjustment is needed. If it is needed, proceed as follows:

1. Loosen the spring mounting eye bolts so that the forward end of the leaf spring can slide fore and aft in the spring hanger.
2. Move the axle forward or backward until it is aligned within the tolerances in the rear axle section of this manual.
3. When the axle is in alignment, install alignment shim(s) to take up the slack between the spring hanger and the spring mounting eye pin.

IMPORTANT: Make sure the same number of shims is installed on both ends of the spring mounting eye pin.

4. Tighten the spring mounting eye bolts 230 N·m (170 lbf·ft).
5. Check the axle alignment again. If necessary, repeat the above procedure until the alignment is within tolerances.



1. Frame Rail
2. Spring Hanger
3. Washer
4. Hexnut
5. Spring Pin
6. Alignment Shim
7. Wear Shoe Clip
8. Washer
9. Spring Pinch Bolt
10. Leaf Spring Assembly
11. U-Bolt Pad
12. U-Bolt
13. Axle
14. Axle Seat
15. Axle Clamp
16. Flatwasher
17. High Nut
18. Shock Absorber Lower Mounting Bracket
19. Shock Absorber
20. Nylon Locknut
21. Washer
22. Air Spring
23. Air Spring Mounting Bracket
24. Shock Absorber Upper Mounting Bracket

Fig. 1, Rear Axle Suspension

Rear Axle Alignment Adjusting

Rear Axle Tracking Adjustment

Single Axle

1. At the forward edge of the right rear tire, measure the distance from the inner side of the tire to the outer side of the right frame rail. See **Fig. 2.**
2. At the rear edge of the left rear tire, measure the distance from the inner side of the tire to the outer side of the left frame rail. See **Fig. 2.**

IMPORTANT: Measurement "A" should not vary by more than 1/4-inch (6 mm) from measurement "B."

3. If measurements "A" and "B" vary by more than 1/4-inch (6 mm), loosen the fasteners holding the lateral torque rod to the frame rail. Add or remove torque-rod shims as needed.
4. For bar-pin style torque rods, tighten the fasteners 136 lbf·ft.

   For taper-pin style torque rods, tighten the fasteners 165 lbf·ft (224 N·m). See **Fig. 3.**

Tandem Axles

1. Check the tracking of the forward-rear axle. For instructions, see "Single Axle" in this subject. Adjust the tracking if needed.
2. At the forward-rear drive axle, measure the distance from the inner side of the right rear tire to the outer side of the right frame rail. Measure at the forward edge of the tire. See **Fig. 4.**

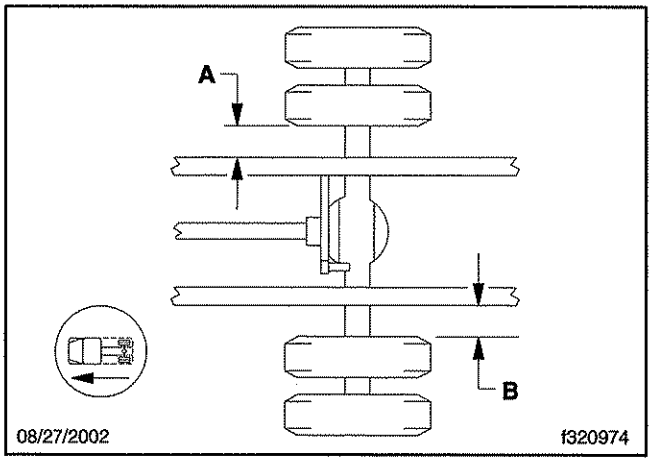


Fig. 2, Rear Axle Tracking Measurements (single axle)

3. At both sides of the rear-rear drive axle, measure the distance from the inner side of the rear tires to the outer side of each frame rail. Measure at the rear edge of each tire. See **Fig. 4.**

IMPORTANT: Measurements "B" and "C" should not vary by more than 1/4-inch (6 mm) from measurement "A."

4. If measurements "B" and "C" vary by more than 1/4-inch (6 mm) from measurement "A," loosen the fasteners holding the axle lateral torque rod at the rear-rear drive axle to the frame rail. Add or remove torque-rod shims as needed.

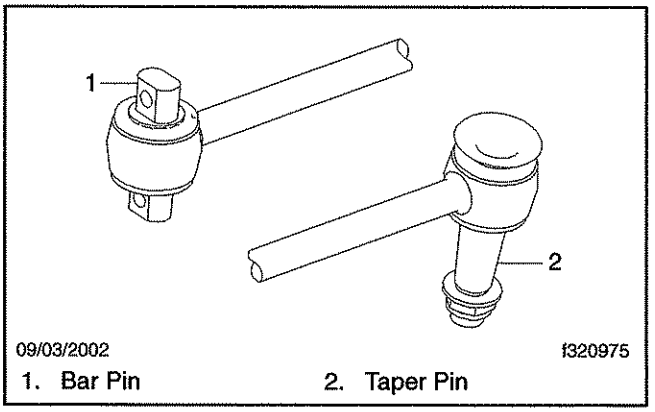


Fig. 3, Torque Rod Types

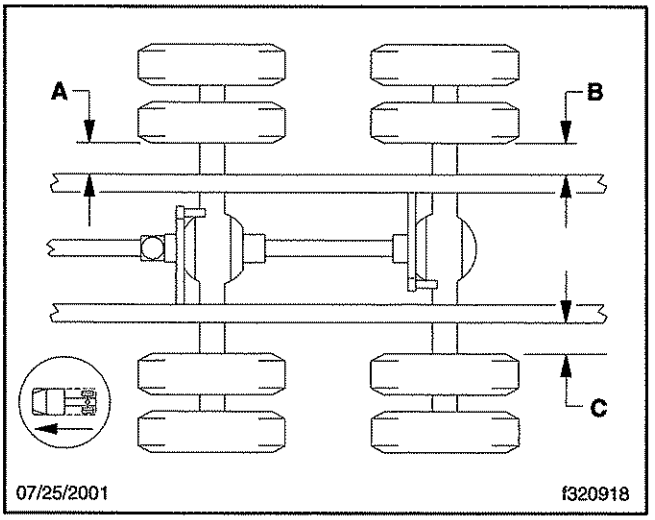


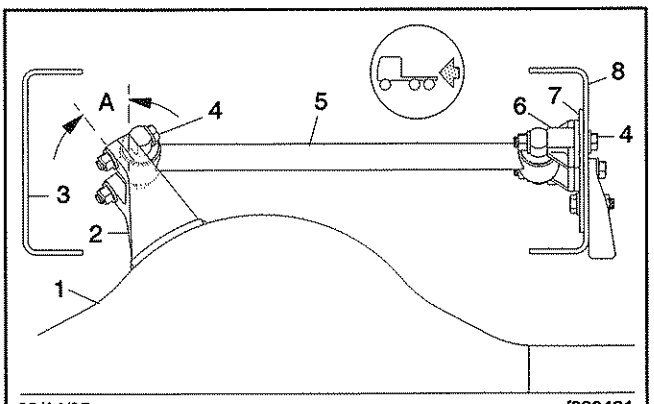
Fig. 4, Rear Axle Tracking Measurements (tandem axles)

5. For bar-pin style torque rods, tighten the fasteners 136 lbf·ft. For taper-pin style torque rods, tighten the fasteners 165 lbf·ft (224 N·m). See **Fig. 3**.

Control Rod Replacement

Replacement

1. Park the vehicle. Shut down the engine, and apply the brakes.
2. Chock the tires. Raise the vehicle. Support the frame rails with jack stands.
3. Remove the fasteners holding the control rod to the frame rail bracket. Remove the shims, and set the shims aside.
4. Remove the control rod.
5. Position the new control rod so that the end with the fasteners angled up at 35 degrees is installed in the axle housing bracket. **See Fig. 1.**
6. Install the fasteners with the bolt heads facing up. Tighten the fasteners enough to hold the control rod in place.
7. Install the shims that were previously removed.
8. Install the other end of the control rod in the frame rail bracket; then, install the fasteners. Tighten the fasteners enough to hold the control rod in place.
9. Tighten all the fasteners 136 lbf·ft (184 N·m).
10. Remove the jack stands. Lower the vehicle. Remove chocks.

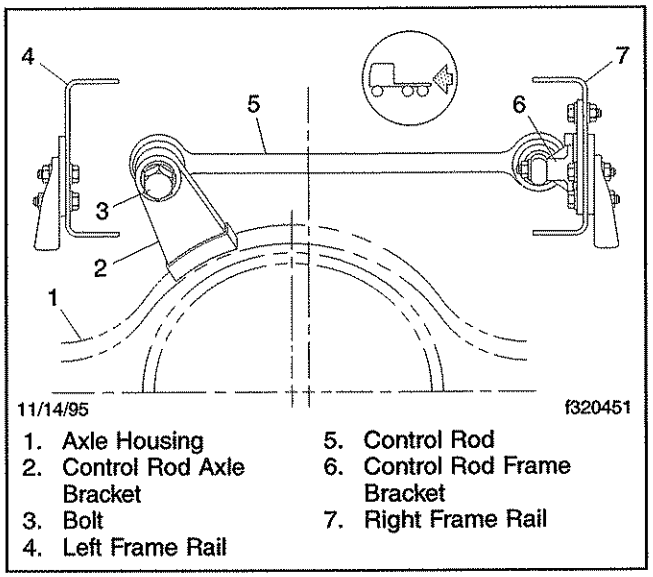


A. Angle: 35 degrees

1. Axle Housing
2. Control Rod Axle Bracket
3. Left Frame Rail
4. Bolt
5. Control Rod
6. Control Rod Frame Bracket
7. Shim
8. Right Frame Rail

Fig. 1, AirLiner Control Rod Installation

NOTE: Control rods on suspensions manufactured to a 23,000-pound (10 433 kg) and 46,000-pound (20 865 kg) weight rating are larger and are attached to the axle bracket with a single bolt. Tighten the fasteners attaching the control rod frame bracket to the frame rail 160 to 170 lbf·ft (217 to 230 N·m), and the bolt connecting the control rod to the axle housing 175 to 225 lbf·ft (237 to 305 N·m). **See Fig. 2.**



1. Axle Housing
2. Control Rod Axle Bracket
3. Bolt
4. Left Frame Rail
5. Control Rod
6. Control Rod Frame Bracket
7. Right Frame Rail

Fig. 2, Control Rod Installation on 23,000-pound and 46,000-pound AirLiner Suspensions

Specifications

Torque Values			
Description	Size	Torque	
		lbf·ft (N·m)	lbf·in (N·cm)
Air Spring Lower Mounting Locknuts	1/2–13	55 (75)	—
Air Spring Upper Mounting Bracket	5/8–11	125 (170)	—
Air Spring Upper Mounting Locknuts	3/4–16	45 (61)	—
	1/2–13	23 (31)	—
Axle U-Bolt High Nuts	7/8–14	Stage 1: Hand-tighten Stage 2: 60 (80)* Stage 3: 200 (270)* Stage 4: 420 to 500 (571 to 680)*	— — — —
Lateral Control Rod Mounting Bolt Nuts	5/8–11	136 (184)	—
Leaf Spring Mounting Eye Bolt Locknuts	5/8–11	170 (230)	—
Leveling Valve Adjustment Nut	1/4–20	—	62 (700)
Leveling Valve Mounting Bolt Nuts	5/16–18	14 (19)	—
Shock Absorber Lower Mounting Nuts	3/4–10	170 (230)	—
Shock Absorber Upper Bracket Mounting Locknuts	5/8–11	125 (170)	—
Shock Absorber Upper Mounting Locknuts (vehicles built before September 1994)	—	Compress bushings to specified dimension.†	—
Shock Absorber Upper Mounting Nuts (vehicles built from September 1994)	3/4–10	170 (230)	—
Spring Hanger Mounting Locknuts	3/4–10	210 (285)	—

* Tighten in a diagonal pattern as shown in **Fig. 1.**
† See **Subject 140.**

Table 1, Torque Values

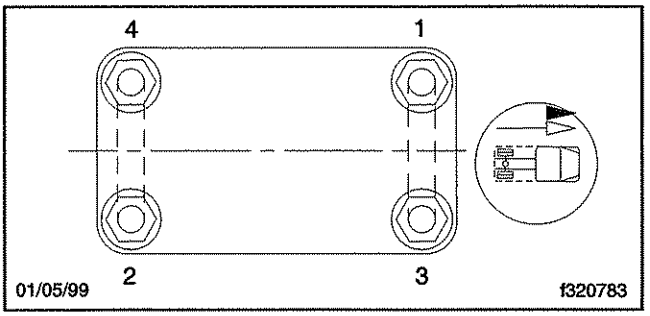


Fig. 1, Tightening Pattern for U-bolt High Nuts

Rough Ride Diagnosis 32.03

Contents

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General Description

Ride quality is determined by a complex interaction of several factors including the vehicle specifications, installed equipment, vehicle speed, suspension loading, and the roughness of the road. An unusual combination of these factors may result in a rough ride.

There are two terms used to describe rough ride conditions: harmonic and harsh. Harmonic ride problems are those in which the once-per-revolution energy input from such things as bent or imbalanced wheels matches the natural frequency of the frame flexing. This produces a fore-and-aft motion in the cab, which continues as long as the critical road speed is maintained. Harmonic ride problems can occur on smooth roads.

Harsh ride problems are those in which the suspension transfers, rather than absorbs, the momentary energy inputs produced when the tires hit bumps or holes in the road. Wavy asphalt, or a series of bumps, may cause repetition of the harsh, jarring motion in the cab, but the motion stops after the tires pass over the bumps. Harsh ride problems occur on rough roads.

This section is designed for use as an aid in locating and correcting rough ride problems. It is not intended for use as a replacement for the detailed service information located in the applicable sections in this manual, or in the component manufacturer's service manuals.

Harmonic Ride Checks

1. Visually check the vehicle for signs of damaged or missing suspension components. Repair or replace the components using the instructions **in the suspension group, the front axle group, or the rear axle group .**
2. Test drive the vehicle.

NOTE: When test driving the vehicle, duplicate as closely as possible the conditions under which the problem occurs. Note the area of the vehicle where the problem seems to be coming from. Pay special attention to this area during the service operations.

3. Chock the tires and apply the parking brakes.
4. Raise the vehicle until the tires are off the ground, and all of the weight is removed from the leaf springs. Block the axle and frame with safety stands. Perform the remedies **under "Troubleshooting, 300: Harmonic Ride, Tires Off the Ground."**

⚠ WARNING

WARNING: Serious personal injury, property damage, or component damage may occur when fasteners are loosened or removed causing unsecured components to drop.

5. Remove the safety stands from under the frame and axle, then lower the vehicle. Perform the remedies **under "Troubleshooting, 300: Harmonic Ride, Tires On the Ground."**

Harsh Ride Checks

1. Visually check the vehicle for signs of damaged or missing suspension components. Repair or replace the components using the instructions **in the suspension group, the front axle group, or the rear axle group .**
2. Test drive the vehicle.

NOTE: When test driving the vehicle, duplicate as closely as possible the conditions under which the problem occurs. Note the area of the vehicle where the problem seems to be coming from. Pay special attention to this area during the service operations.

3. Perform the corrections under **"Troubleshooting, 300: Harsh Ride, Tires On the Ground."**
4. If the problem persists, perform the harmonic ride checks in this subject. Occasionally, ride problems associated with rough roads are harmonic ride problems masked by the road conditions.

Problem—Harmonic Ride, Tires Off the Ground

Possible Cause	Remedy
Bent, distorted, or out-of-round wheels or rims are causing a rough ride.	Inspect and repair the assemblies using the instructions in the **wheels and tires group.**
Bent, distorted, or out-of-round brake drums or hubs are causing a rough ride.	Replace damaged components using the instructions in the **front axle group** or the **rear axle group.**
An improperly seated tire-to-rim bead is causing an out-of-round assembly.	Inspect the tires and rims for proper bead seating. Correct the problem using the instructions in the **wheels and tires group.**
A tire and rim assembly on spoke wheels is improperly installed, causing an out-of-round assembly.	Remove and install the tire and rim assembly using the instructions in the **wheels and tires group.**
Worn or distorted rim spacers are causing an out-of-round assembly.	Replace damaged spacers using the instructions in the **wheels and tires group.**
The wheels, brake drums, or hub assemblies are out of balance.	Inspect the components for missing balance weights. Balance, as necessary.
Radial force variations in the tires are causing a rough ride.	Exchange the tires and wheels with a set that is known to cause no ride problems. If this corrects the problem, discard the old tires. For instructions, **refer to the wheels and tires group.**

Problem—Harmonic Ride, Tires On the Ground

Possible Cause	Remedy
Worn or loose cab mounts allow the cab to bounce.	With a long bar, lever the cab legs up and down. If there is looseness, replace or tighten the mounts, as necessary.
Forces from the trailer suspension are pushing on the tractor fifth wheel.	Review the ride problems in this subject that apply to the trailer suspension. Perform the corrections, as necessary.

Problem—Harsh Ride, Tires Off the Ground

Possible Cause	Remedy
Seized front spring shackle pins are not allowing the springs to flex.	Replace the seized shackle pins. For instructions, refer to the applicable front suspension section in this service manual group.

Problem—Harsh Ride, Tires On the Ground

Possible Cause	Remedy
The tires are improperly inflated.	Adjust the tire pressure using the instructions in the wheels and tires group of the maintenance manual.
The frame is bottoming out against the suspension.	Check the suspension for weak or damaged springs or components. Inspect the springs for "gull-winging" when the vehicle is loaded. Replace the spring assembly, as necessary, using the instructions in the **suspension group.**
	Reduce the overall loaded weight on each axle to conform with the maximum spring load capacities on the vehicle specification sheet. Do not exceed the maximum spring load capacities.
	Adjust the air spring height using the instructions in the **suspension group.**
The vehicle normal loaded weight is markedly below the spring load capacity.	Customers should contact a Freightliner dealer for the correct application of a lower rated spring. Replace the spring assembly using the instructions in the **suspension group.**

Troubleshooting

Possible Cause	Remedy
When the vehicle is loaded, the front axle spring shackle angle is not within the rearward 3 to 18 degree angle.	Customers should contact a Freightliner dealer for shackle angle corrective measures. **Refer to the suspension group** for service instructions.
The weight on the tractor fifth wheel is causing overloading on the front axle springs.	Change the loading pattern on the trailer.
Forces from the trailer suspension are pushing on the tractor fifth wheel causing a rough ride condition.	Review the ride problems in this subject that apply to the trailer suspension. Perform the corrections, as necessary.

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General Description

Hendrickson RT and U series suspensions **(Fig. 1 and Fig. 2)** use leaf springs to absorb road shock. The forward and rear ends of each spring assembly ride in hangers attached to the frame rails, and the spring assembly rests on a saddle connected to an equalizing beam. Each end of the beam is secured to beam hangers welded on the vehicle axles.

NOTE: No alignment adjustments are needed for RT and U suspensions; alignment is determined by the placement of the spring hangers on the frame rails, and the beam hangers on the axle housings.

To allow for spring length change caused by spring deflection, the forward end of each spring assembly is secured to the number one hanger by a pin that runs through the legs of the hanger and through the spring eye. The spring eye contains a bronze bushing, and the pin that runs through the eye and the spring hanger legs is hardened steel with lubrication channels. The pin is also notched to allow two bolts to pass through the spring hanger legs and lock the pin in place.

The rear end of the spring assembly isn't fastened to the number two spring hanger; instead, the spring rests against the rounded underside (or cam) of the hanger and is free to rub against the hanger as the spring assembly changes length due to deflection caused by vehicle weight and road shock.

A spacer runs between the legs of the number two spring hanger to prevent the spring assembly from moving out of position against the hanger.

U series suspensions are light-weight versions of the RT suspensions, and use U-bolts to hold the spring assembly on the saddle. RT suspensions use four bolts that run down through the spring top pad to hold the spring assembly on the saddle.

Hendrickson RT suspensions also feature a "pilot cup" (similar to a raised disk), forged upward in the main spring leaf around the center bolt. This cup fits into the spring top pad to ensure the spring assembly is positioned correctly in the saddle. U suspensions feature similar pilot cups **(see Fig. 3),** but the U pilot cups are forged downward, around the center bolt to ensure the spring assembly is positioned correctly in the saddle.

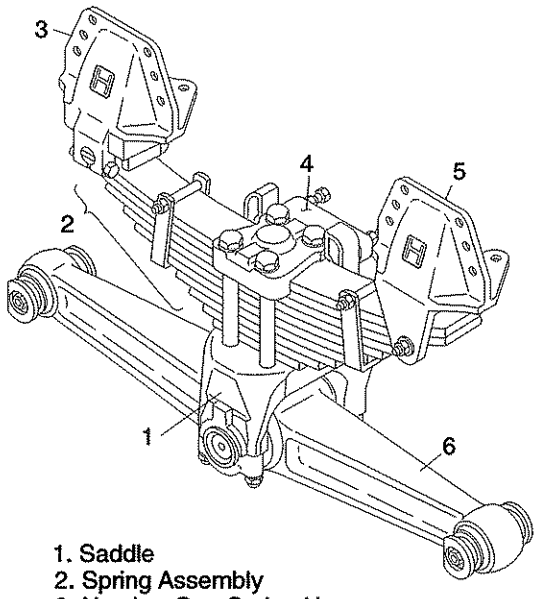
Because of this difference in pilot cups, springs for the two types of suspensions are not interchangeable.

RTE and UE series suspensions **(Fig. 4 and Fig. 5)** are basically the same as the RT and U suspensions, but feature longer spring assemblies that require a third spring hanger. This design provides a two-stage spring rate, depending on the vehicle load. When the vehicle is unloaded, there should be a 3/8-inch gap between the top spring and the number two spring hanger, and the rear end of the spring assembly should rest against the number three spring hanger.

Loaded **(see Fig. 5),** the springs deflect until the spring assembly rests against all three spring hangers.

On all models of RT and U suspensions, torque rods—mounted between the axle housings and the frame rails— prevent the axles from twisting or shifting side-to-side as the vehicle accelerates, stops, or corners.

All suspension fasteners require periodic tightening. For suspension inspecting, lubricating, and fastener torque checking instructions, refer to the suspension section in the vehicle maintenance manual.



1. Saddle
2. Spring Assembly
3. Number One Spring Hanger
4. Spring Top Pad
5. Number Two Spring Hanger
6. Equalizing Beam

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Fig. 1, RT Suspension

General Description

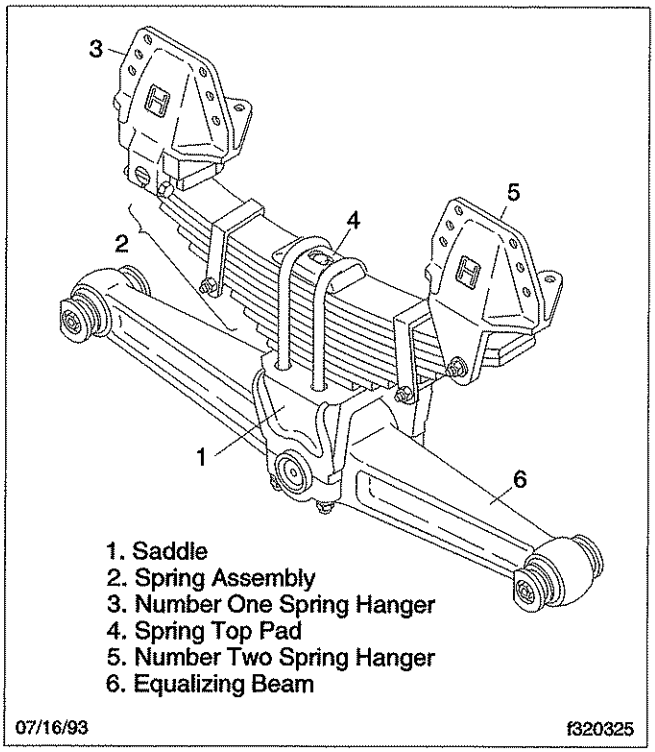


Fig. 2, U Suspension

⚠ WARNING

WARNING: Failure to periodically torque the suspension fasteners could result in damage to the frame hangers or separation of components. This could cause a loss of vehicle control, resulting in injury or property damage.

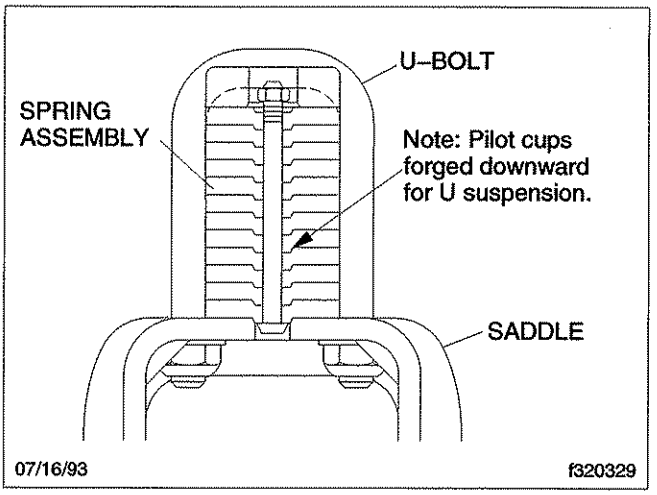


Fig. 3, Pilot Cups (cross-section view of springs)

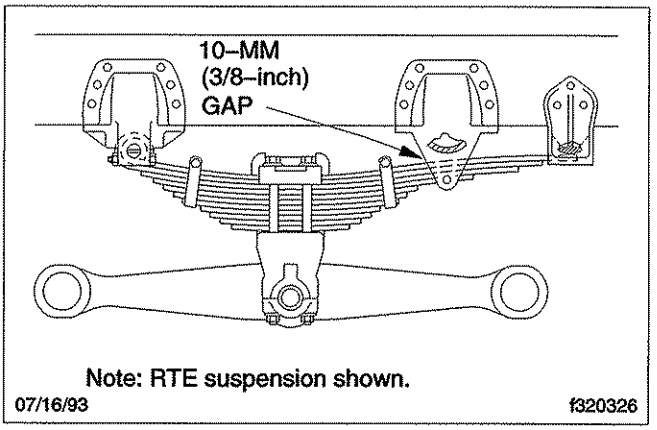


Fig. 4, Unloaded Suspension

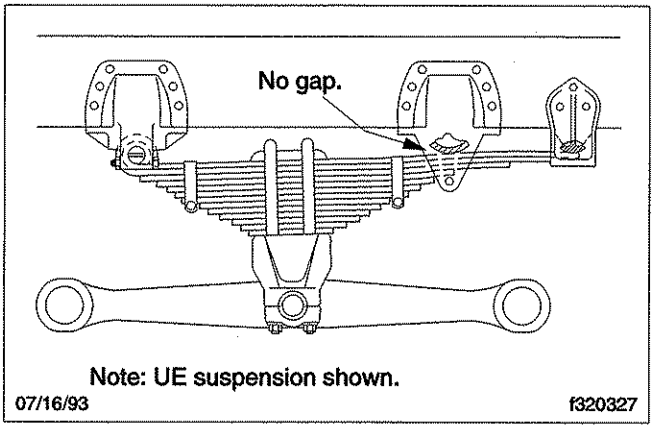


Fig. 5, Loaded Suspension

Removal (Refer to Fig. 1 or Fig. 2)

1. Chock the front tires.
2. Drain the vehicle air system.
3. Disconnect all air lines leading to the rear axles, marking the lines for later assembly reference. Plug or cap all lines and fittings to prevent dirt from entering the system.
4. Disconnect the driveline rear universal joint from the forward-rear axle.
5. Manually release the spring brake chambers. For instructions, **refer to the brakes group.**

⚠ WARNING

WARNING: When the torque rods are disconnected from the axle brackets, the axles become free to pivot on the equalizer beam end bushings. Keep clear of the beam hangers and beam ends to avoid possible injury.

6. Remove the torque rods. For instructions, **refer to Subject 170.**

   To prevent the axles from pivoting, secure chains between the crosstube and each fore and aft torque rod axle mounting bracket.

7. Raise the rear of the vehicle so that all weight is removed from the suspension. Then, block the axles and the frame with safety stands. Make sure the stands will securely support the weight of the axles and the frame.

NOTE: Do not raise the vehicle to the point where the weight of the suspension and axles hangs from the vehicle.

8. Remove the saddle cap nuts and washers from each side of the vehicle, and remove the saddle caps.

NOTE: If the saddle cap studs are damaged, replace them.

9. Raise the rear of the vehicle frame until there is enough clearance to roll the axles out from under the vehicle. Install safety stands under the frame, then roll the axles— with the equalizer beams attached— out from under the vehicle.

Installation (Refer to Fig. 1 or Fig. 2)

1. Roll the axles under the vehicle frame. Align the center bushing of each equalizer beam with the center of the saddle legs.
2. Raise the vehicle frame off the safety stands, then remove the safety stands.
3. Lower the frame, centering the saddles on the beam center bushings.
4. Lubricate the saddle cap studs with SAE 20 oil. Install the saddle caps, washers and new self-locking nuts. Do not tighten.
5. Install the torque rods. For instructions, **refer to Subject 170.**

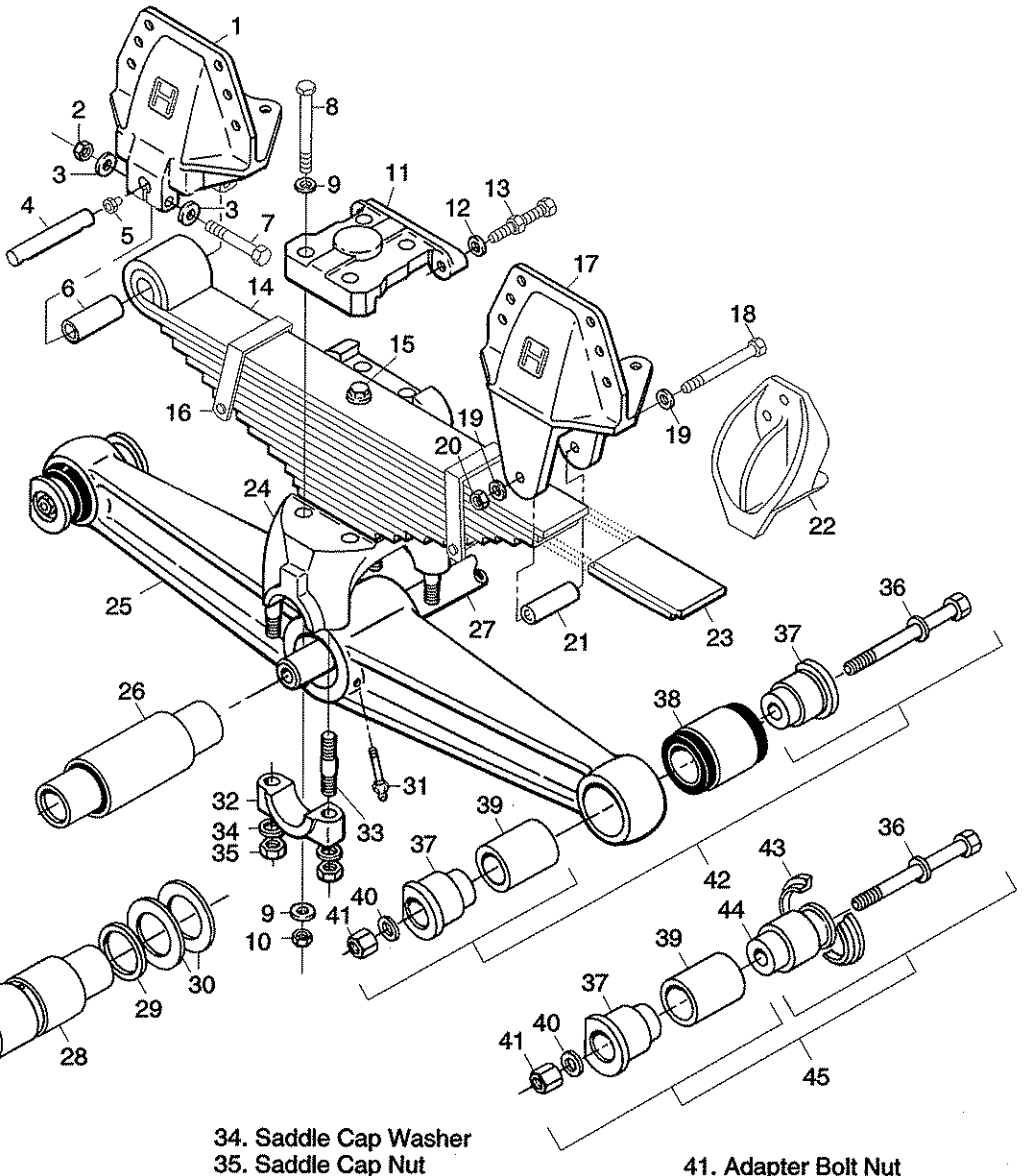
   Remove the chains between the crosstube and each fore and aft torque rod axle mounting bracket.

6. Tighten the saddle cap locknuts to the applicable torque in the torque table in **"Specifications, 400."**

NOTE: Maintain an even gap between the saddle cap and the saddle when tightening the self-locking nuts **(see Fig. 3).**

7. Remove the safety stands from under the frame and axle, and lower the vehicle.
8. Manually reset the spring brake chambers. For instructions, **refer to the brakes section.**
9. Connect the driveline rear universal joint to the forward-rear axle. For instructions, **refer to the driveline components section.**
10. Uncap all air lines and fittings, then connect the lines leading to the rear axles.

Suspension Removal and Installation



1. Forward (no. 1) Spring Hanger
2. Locknut
3. Washer
4. Spring Pin
5. Grease Fitting
6. Spring Eye Bushing
7. Lock Bolt
8. Top Pad Bolt
9. Top Pad Washer
10. Top Pad Locknut
11. Top Pad
12. Setscrew Washer
13. Setscrew and Locknut
14. Spring Assembly
15. Spring Center Bolt and Nut
16. Spring Alignment Clip
17. Rear (no. 2) Spring Hanger
18. Rebound Spacer Bolt
19. Spacer Bolt Washer
20. Spacer Bolt Locknut
21. Rebound Spacer
22. RTE Rear (no. 3) Spring Hanger
23. RTE Spring Extension
24. Saddle Assembly
25. Equalizer Beam Assembly
26. Rubber Center Bushing
27. Crosstube
28. Bronze Center Bushing
29. Bushing Grease Seal
30. Thrustwashers
31. Grease Fitting (Bronze Bushing)
32. Saddle Cap
33. Saddle Cap Stud
34. Saddle Cap Washer
35. Saddle Cap Nut
36. Adapter Bolt and Washer
37. Adapter
38. End Bushing
39. Intermediate Tube
40. Adapter Bolt Washer
41. Adapter Bolt Nut
42. Adapter–Type End Support Assembly
43. Split–Ring
44. Adapter Plug
45. Split–Ring Adapter Assembly

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Fig. 1, RT and RTE Series (exploded view)

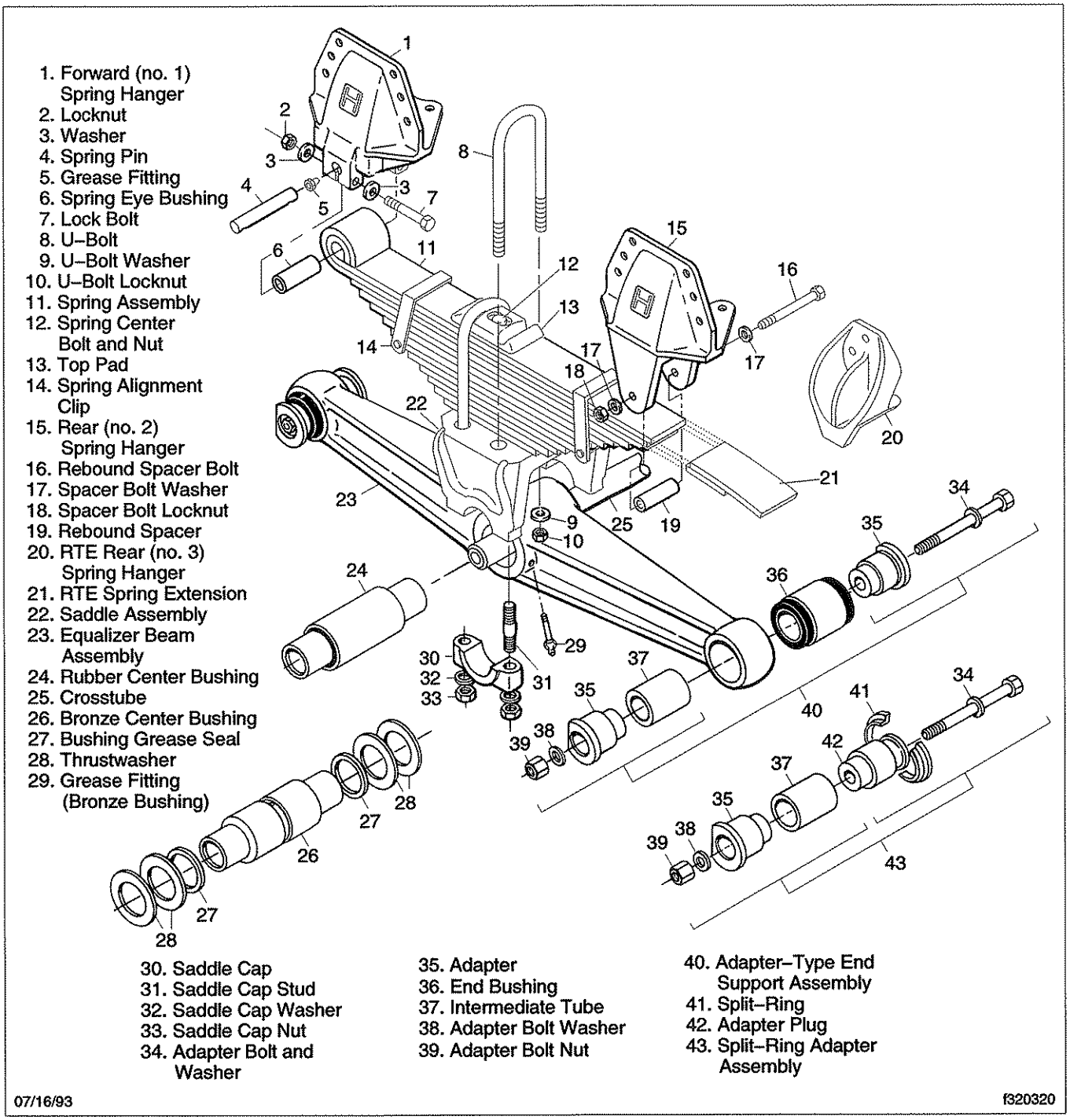


Fig. 2, U and UE Series (exploded view)

Suspension Removal and Installation

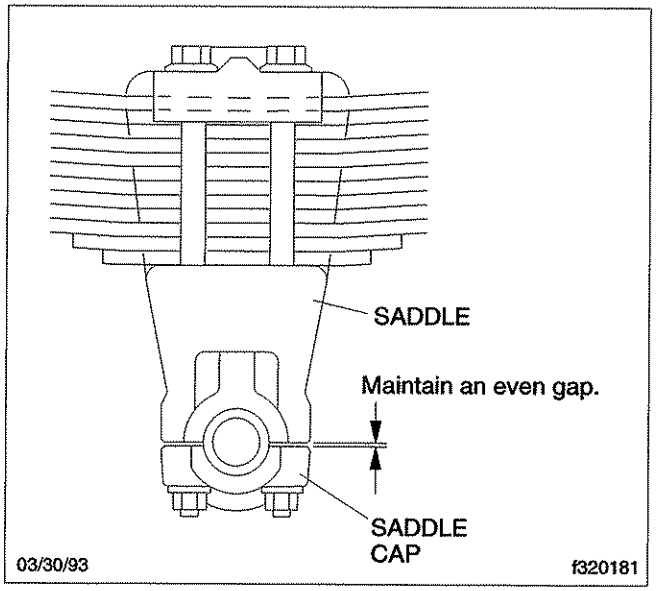


Fig. 3

Spring and Saddle Removal and Installation

Removal

1. Remove the suspension. For instructions, **refer to Subject 100.**
2. Support the spring and saddle assembly with a floor jack.
3. Remove the locknuts from the spring pin lockbolts; then remove the lockbolts and washers from the number one spring hanger.
4. Using a suitable drift, drive the spring pin through the no. 1 spring hanger and out the inboard side of the spring hanger **(see Fig. 1).**
5. Remove the locknut and lockwasher from the rebound spacer bolt in the no. 2 spring hanger. Remove the rebound spacer bolt and the spacer.

⚠ WARNING

WARNING: The leaf spring assembly is heavy. Use care when handling it to prevent injury.

6. Lower the spring and saddle assembly from the spring hangers.
7. Remove the spring assembly from the saddle.

   7.1 *On RT series suspensions ,* loosen the spring alignment setscrews on the top pad, and remove the top pad locknuts, washers, bolts, and top pad.

   On U series suspensions , remove the U-bolt locknuts, washers, U-bolts, and U-bolt top pad.

   7.2 Lift the spring assembly from the saddle.

Installation

1. Seat the leaf spring assembly on the saddle.
2. Install the spring assembly on the saddle.

   2.1 Position the top pad on the spring assembly, and check that the pad is seated on the spring center-bolt.

   IMPORTANT: The pilot cups on U springs are forged downward around the spring center-bolt and fit in a pilot hole in the saddle; therefore, springs for RT and U suspensions are not interchangeable.

   NOTE: On RT series suspensions, the main leaf has a pilot cup forged upward around the center-bolt. This cup serves as a pilot when installing the top pad, and ensures correct alignment of the spring assembly.

   2.2 Lubricate the threads of the top pad bolts or U-bolts with SAE 20 oil.

   On RT series suspensions , install washers on the top pad bolts, and install the bolts through the top pad and saddle. Secure the bolts with new washers and nuts, and tighten the nuts finger-tight.

   On U series suspensions , install the U-bolts over the top pad and spring assembly, and through the saddle. Secure the bolts with new washers and nuts, and tighten the nuts finger-tight.

   2.3 *On RT series suspensions ,* lubricate the threads on the spring setscrews with SAE 20 oil. Hand-tighten the spring setscrews against the leaf springs, then tighten them 135 to 203 N·m (100 to 150 lbf·ft). Tighten the setscrew locknuts until the lockwashers are locked.

   Tighten the top pad locknuts 373 to 542 N·m (275 to 400 lbf·ft). Use the tightening sequence shown in **Fig. 2.**

   On U series suspensions , tighten the locknuts evenly 320 to 410 N·m (237 to 302 lbf·ft) Using a hammer, tap the tops of the U-bolts to settle the assembly, then tighten

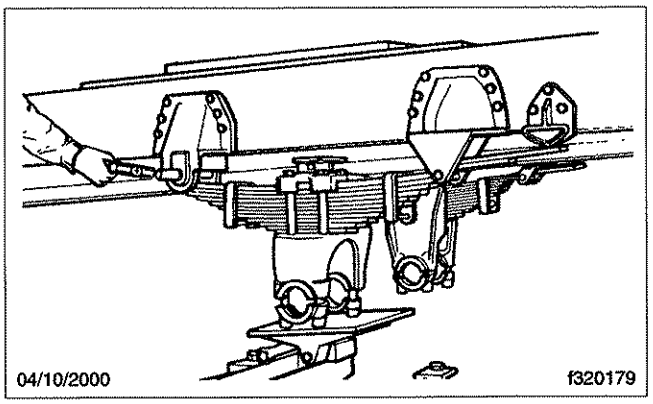


Fig. 1

Spring and Saddle Removal and Installation

the locknuts 320 to 410 N·m (237 to 302 lbf·ft).

⚠ CAUTION

CAUTION: Failure to tap the U-bolts and tighten the locknuts a second time could allow the assembly to loosen, damaging the pilot hole in the saddle seat.

3. Position the spring and saddle assembly into the no. 1 and no. 2 spring hangers.
4. Coat the spring pin and the inside diameter of the spring eye bushing with multipurpose chassis grease.
5. Align the spring pin with the spring eye bushing in the forward spring hanger.
6. From the outboard side of the spring hanger, tap the spring pin into the bushing with a soft hammer. If necessary, adjust the spring to assist spring pin entry.
7. Place washers on the spring pin lockbolts, and insert the lockbolts through the spring hanger. If necessary, use a screwdriver to turn the spring pin until the lockbolts can slide past it.
8. Lubricate the lockbolt threads with SAE 20 oil. Install the lockwashers and locknuts. Tighten the locknuts 61 to 85 N·m (45 to 63 lbf·ft).

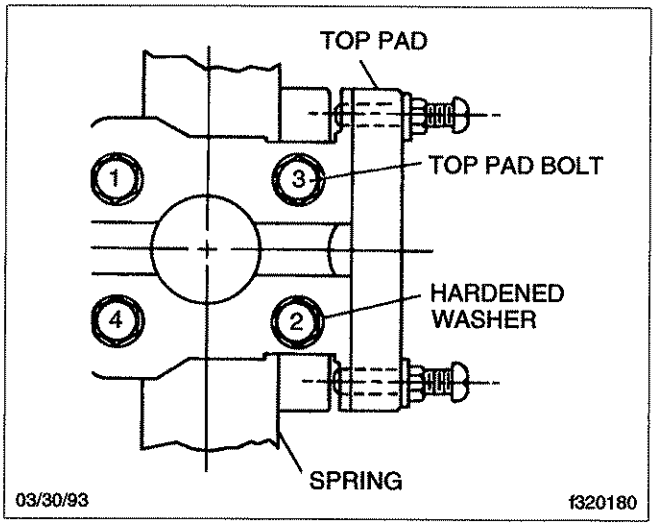


Fig. 2, Top Pad Bolt Tightening Sequence

9. Position the rebound spacer in the no. 2 spring hanger leg, then install the rebound spacer bolt, lockwasher, and locknut. Tighten the locknut 51 to 61 N·m (38 to 45 lbf·ft).
10. Install the grease fittings in both spring eye pins. Apply multipurpose chassis grease to the grease fittings until grease appears on both sides of the spring eye bushings.
11. Install the suspension. For instructions, **refer to Subject 100.**

Spring Leaf, Spring Pin, and Spring Eye Bushing Checking and Replacement

Checking

1. Shut down the engine, apply the parking brakes, and chock the tires.
2. Check for spring eye bushing or pin damage.
   - 2.1 Place a block of wood on the spring **(see Fig. 1),** and with a pry bar, try to lift the spring hanger and frame rail. Note how much movement occurs around the spring eye pin.
   - 2.2 With the vehicle unloaded, try to rock the chassis back and forth. Note how much movement occurs around the spring eye pin.
   - 2.3 In either case, if 3 mm (1/8 inch) or more movement occurs between the spring eye pin and the spring bushing, replace the bushing.

   NOTE: Movement around the spring eye pin can also indicate a broken spring eye. In this case, replace the main leaf or the spring assembly.
3. Remove the chocks from the tires.

Replacement

1. Remove the spring and saddle assembly. For instructions, **refer to Subject 110.**
2. Using a C-clamp to hold the spring leaves together, remove the center-bolt and nut, and the spring alignment clips. Remove the C-clamp and separate the leaves.

⚠ WARNING

WARNING: Commercial cleaning solvents are toxic, can cause severe skin irritation, and may be fire hazards. When using solvents, follow the safety precautions recommended by the solvent manufacturer.

3. Using a wire brush and solvent, clean all grease, dirt, and rust from the spring leaves. Inspect the spring leaves for cracks, gouges, wear, or abnormal bends. The no. 1 main and no. 2 wrapper spring leaves (the top two spring leaves) may each be replaced; if equipped with the RTE or UE series suspension, the nos. 1, 2, and 3 spring leaves (the top three spring leaves) may each be replaced. If a spring leaf is damaged below these numbers in a pack, replace the spring assembly. Replace both spring assemblies to ensure even spring deflection.
4. Inspect the spring pin and spring eye bushing for wear or damage. If the pin diameter is less than 1.367 inch, replace it. If the inside diameter of the spring eye bushing is more than 1.395 inch, replace it.

NOTE: If necessary, press out the bushing with a hydraulic press. Install the new bushing with the split of the bushing positioned at the top (30 degrees) of the spring eye **(see Fig. 2).**

5. Position the spring leaves in order, then insert a drift through the center-bolt hole to align the leaves.
6. Compress the leaves with a C-clamp, then install the spring alignment clips on the spring leaves. Install the spring alignment clip nuts and bolts. Tighten the nuts 20 N·m (15 lbf·ft).
7. Remove the drift punch. At the bottom of the spring, insert a new center-bolt. Install a new

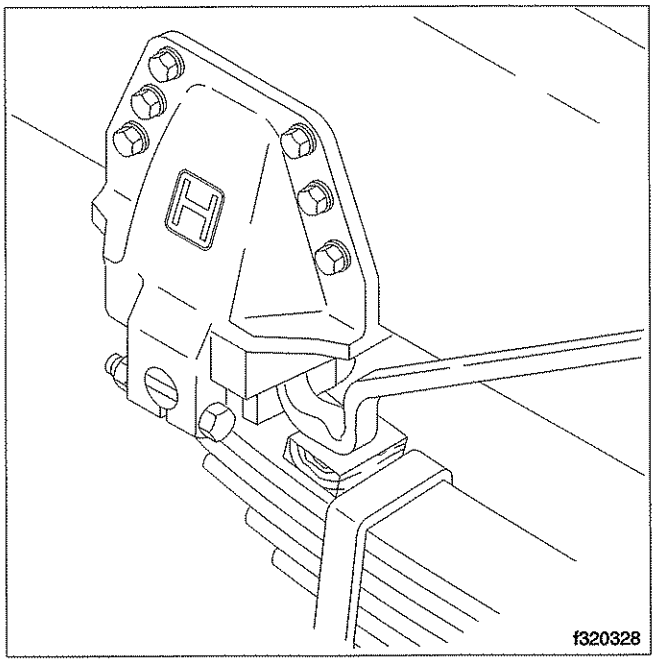


Fig. 1

Spring Leaf, Spring Pin, and Spring Eye Bushing Checking and Replacement

center-bolt nut and tighten to the value in the torque table in **"Specifications, 400."**

8. Install the spring and saddle assembly. For instructions, **refer to Subject 110.**

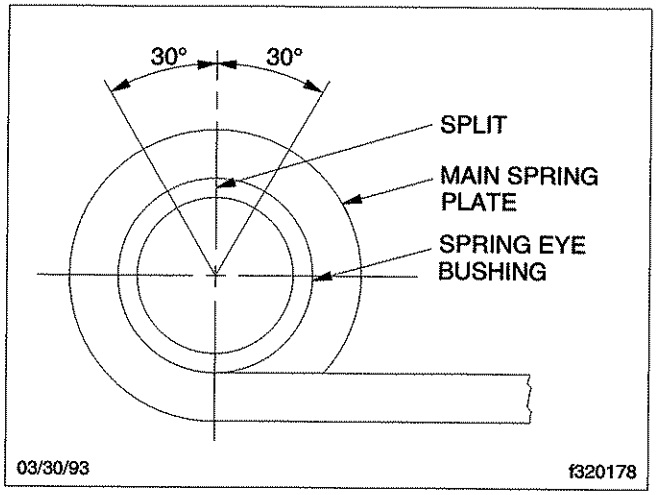


Fig. 2

Equalizer Beam Adapter- and Tube-Type End Support Removal and Installation

Removal

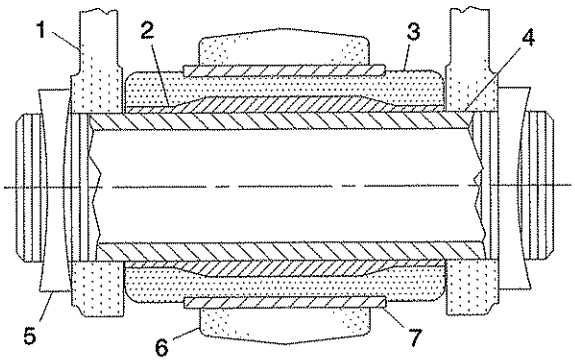
IMPORTANT: To ensure that the required tools are available, see the table of special tools **"Specifications, 400,"** before beginning these procedures. Special tools are available from the Owatonna Tool Company, Owatonna, Minnesota, or an affiliated dealer. Although these tools are recommended, shop-made adapters can be used if a vertical hydraulic press with a 50-ton capacity is available. Dimensions for the shop-made adapters are provided in the table in **"Specifications, 400."**

1. Chock the front tires.
2. Remove the saddle cap nuts and washers, then remove the saddle cap. Support the equalizer beam with safety stands.
3. Raise the rear of the vehicle until the saddle studs clear the equalizer beam. Block the axles and frame with safety stands.
4. Remove the wheels and tires. For instructions, **refer to the wheels and tires group.**
5. Remove the brake shoes, brake spider, and brake backing plate (dust shield). **Refer to the rear axle group** for instructions.
6. Apply a penetrating oil to all beam end connections.
7. On a tube-type end support **(see Fig. 1),** remove the tube nuts from both sides of the beam end tube.

   On an adapter-type end support **(see Fig. 2),** remove the nut, washers, and the adapter bolt.
8. If using Owatonna tools, remove the tube-type end supports by positioning the receiving tube over the outboard end of the beam end tube. Position the hydraulic ram, pulling screw, speed nut, and the removing adapter **(see Fig. 3).** Connect a hydraulic pumping unit to the ram, and apply pressure to remove the beam end tube.
9. Remove the adapter-type end supports (if using Owatonna tools).

   9.1 Using either a 7/8-or 15/16-inch hand-tap **(see Fig. 4),** tap the adapter bolt hole (outboard side) to a depth of about 38 mm (1-1/2 inches).

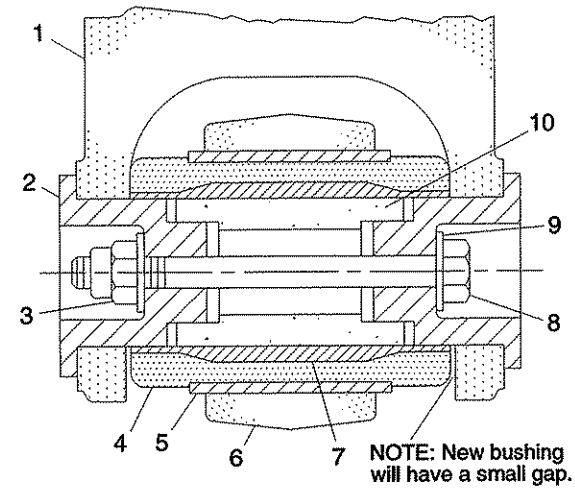
   NOTE: Determine the correct size of hand-tap by using the plug gauge. If the gauge passes through the adapter bolt hole, use a 15/16-inch tap; if it doesn't, use a 7/8-inch tap.



1. Axle Beam Hanger
2. Bushing Inner Sleeve
3. Rubber End Bushing
4. Beam End Tube
5. End Tube Nut
6. Equalizer Beam
7. Bushing Outer Sleeve

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Fig. 1, Equalizer Beam Tube-Type End Support



1. Axle Beam Hanger
2. Adapter
3. Adapter Bolt Nut
4. Rubber End Bushing
5. Bushing Outer Sleeve
6. Equalizer Beam
7. Bushing Inner Sleeve
8. Adapter Bolt
9. Washer (both ends)
10. Intermediate Tube

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Fig. 2, Equalizer Beam Adapter-Type End Support

Equalizer Beam Adapter- and Tube-Type End Support Removal and Installation

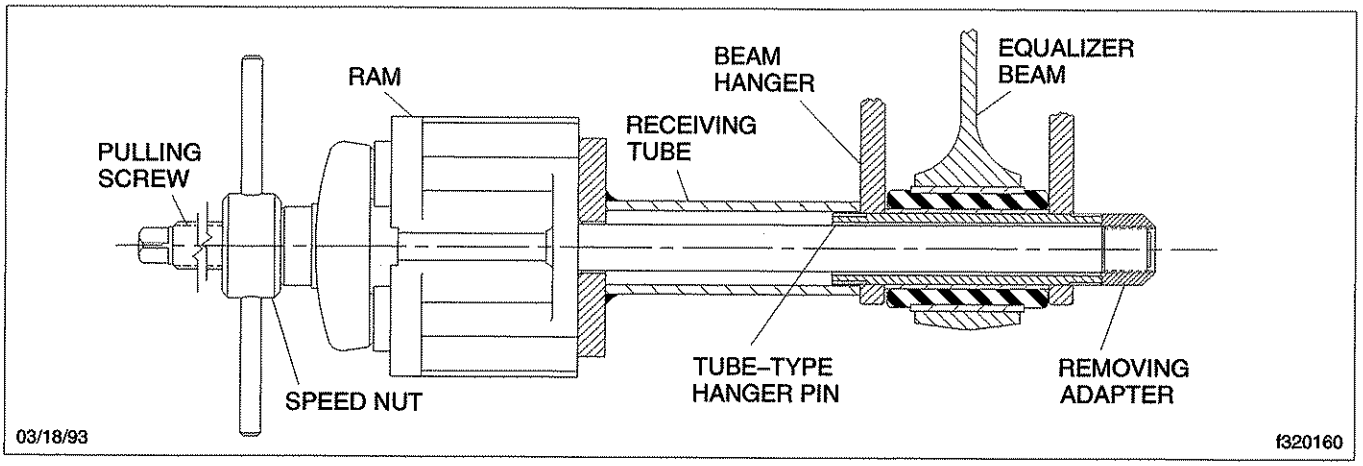


Fig. 3, Tube-Type Beam End Removal

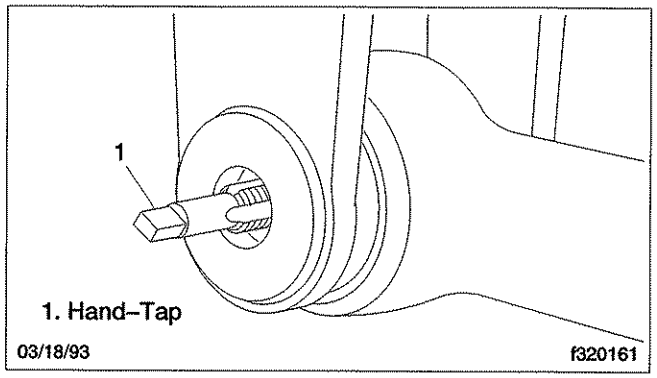


Fig. 4

9.2 On the outboard side of the axle, thread the removing screw into the tapped hole. Position the receiving cup and hexnut on the removing screw **(see Fig. 5).** Turn the hexnut until the adapter plug breaks loose and bottoms on the inside of the receiving cup. If needed, add spacers to complete removal of the adapter plug. **See Fig. 6.**

9.3 On the inboard side of the axle, position the receiving cup over the adapter plug. On the outboard side of the axle, insert the removing screw through the receiving cup and secure it with the hexnut. **See Fig. 7.**

9.4 Hold the removing screw and turn the nut with a 1-1/2 inch open-or box-end wrench. Turn the nut until the adapter plug bottoms on the inside of the receiving cup.

10. Remove the end supports (if not using Owatonna tools).

10.1 For tube-type end supports, install a spacer bushing between one end-tube nut and the beam hanger. Tighten the nut to pull the end tube out of the beam end bushing. If the tube doesn't come loose, use a hacksaw and saw the tube along the inside surface of both axle beam hanger legs.

⚠ WARNING

WARNING: Don't use a cutting torch to remove the equalizer beams from the beam hangers. The equalizer beams are heat treated, and using a

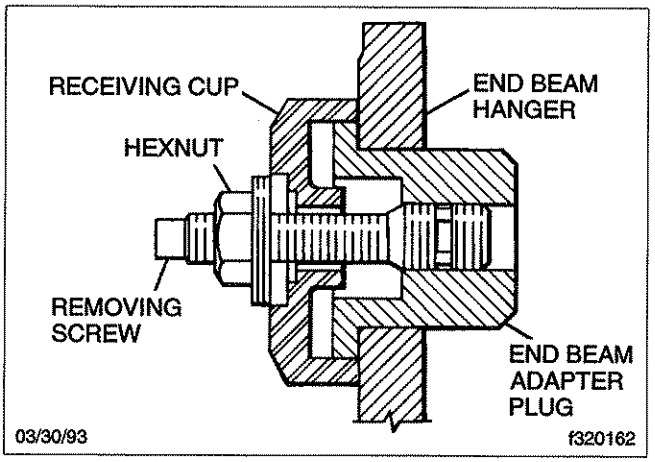


Fig. 5

Equalizer Beam Adapter- and Tube-Type End Support Removal and Installation

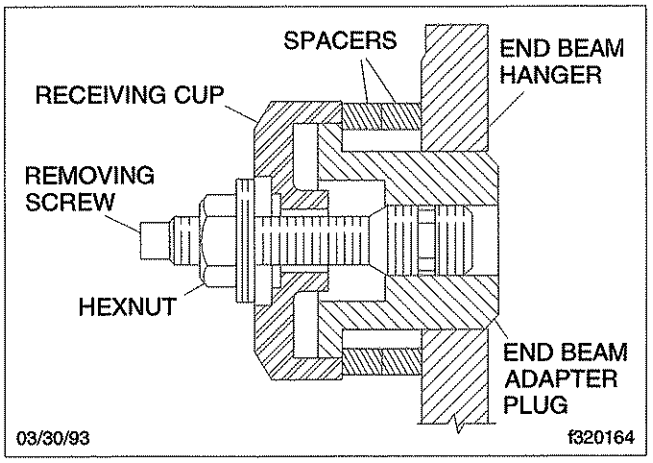


Fig. 6

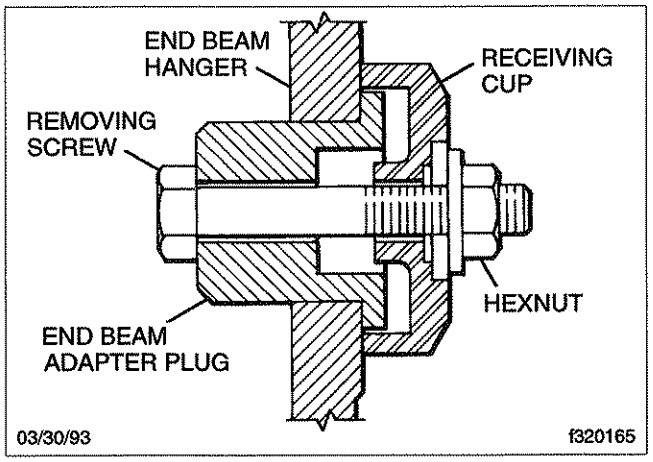


Fig. 7

cutting torch could weaken them. This could result in a loss of vehicle control and possible personal injury.

10.2 For adapter-type end supports, a relief is located on each side of the adapter **(see Fig. 8).** Turn the adapter with an air chisel, then insert a chisel into the relief on the inboard adapter. Drive the chisel in and wedge the adapter out of the beam hanger. Do the same on the outboard adapter.

If a split-ring adapter is used, drive a chisel between the two halves to remove the end support plug. Drive the plug into the equalizer beam end bushing until it is clear of the beam hanger. After the equalizer beam is removed, drive the adapter plug out of the bushing.

11. Remove the ends of the equalizer beams from the axle beam hangers.

12. Lower the equalizer beams and the crosstube to the ground. Remove the thrustwashers and pull the beams from the crosstube.

Installation

1. On adapter-type end supports, apply Texaco Compound L, or an equivalent rust preventive lubricant, to the axle beam hanger eyes,

   beam end bushing inner sleeve, end support adapters, outside surface of the bushing intermediate tubes, and the ends of the crosstube.

   Install the crosstube and thrustwashers in both equalizer beam center bushings.

   On tube-type end supports, apply Texaco Compound L, or an equivalent rust preventive lubricant, to the axle beam hanger eyes, beam end bushing inner sleeve, outer surface of the beam end tubes, beam center bushing inner sleeves, and the ends of the crosstube.

   Using SAE 20 oil, lubricate the threads of the beam end tube, then install the crosstube and thrustwashers in both equalizer beam center bushings.

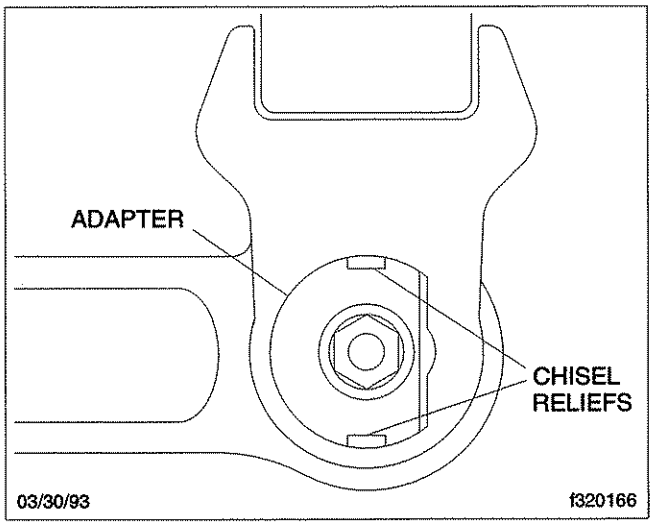


Fig. 8

Equalizer Beam Adapter- and Tube-Type End Support Removal and Installation

2. Position the equalizer beam assembly under the axles, then raise the assembly and place the forward ends of each beam in the forward-rear axle beam hangers. Align the beam end bushings with the beam hangers.

   On adapter-type end supports, install the intermediate tubes, the adapters, the adapter bolt, washers, and nut in each beam end to hold the beam in the axle beam hangers. Do not tighten.

   On tube-type end supports, install the beam end tubes through the beam hangers and the beam end bushings. Hand-tighten both nuts on the beam end tubes.

3. Place the rear ends of each beam in the rearmost axle beam hangers. Align the beam end bushings with the beam hangers.

   On adapter-type end supports, install the intermediate tubes, the adapters, the adapter bolt, washers, and nut in each beam end to hold the beam in the axle beam hangers. Do not tighten.

   On tube-type end supports, install the beam end tubes through the beam hangers and the beam end bushings. Hand-tighten both nuts on the beam end tubes.

4. Position the saddle caps on the saddle cap studs, then install the washers and new self-locking nuts. Tighten the nuts to the applicable torque in the torque table in **"Specifications, 400."**

5. Tighten the adapter bolt nuts 285 to 325 N·m (210 to 240 lbf·ft). Make sure the flat section of the adapter flange is in the vertical position. **See Fig. 9.**

6. Tighten the end tube nuts 508 to 576 N·m (375 to 425 lbf·ft).

⚠ WARNING

WARNING: The adapter bolt nuts and end tube nuts must be tightened to the specified values. If not, the metal surfaces of the end support assembly will rub, and excessive wear to the beam hanger legs and end bushing inner sleeves will occur. This could result in separation of suspension components, loss of vehicle control, and possible injury or property damage.

7. Install the brake backing plate (dust shield), brake spider, and brake shoes. **Refer to the rear axle group** for instructions.

8. Install the wheels and tires. For instructions, **refer to the wheels and tires group.**

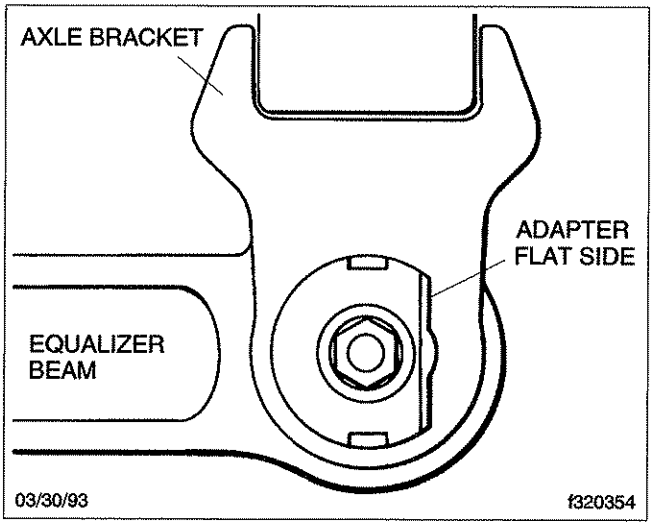


Fig. 9

Equalizer Beam End Bushing Removal and Installation

Removal

⚠ WARNING

WARNING: Don't use a cutting torch to remove the beam end bushing. Equalizer beams are heat treated by the manufacturer. Using a cutting torch could weaken the beams, and may result in a loss of vehicle control. This could cause personal injury or property damage.

1. Remove the equalizer beam ends from the axle beam hangers. For instructions, **refer to Subject 130.**
2. Cut off the protruding rubber from one side of each beam end bushing **(see Fig. 1).**
3. Remove the beam end bushings (if using Owatonna tools, refer to **Fig. 2**).
   - 3.1 Install the receiving adapter on the receiving tube.
   - 3.2 Position the hydraulic ram and slide the pulling screw through the end bushing.
   - 3.3 Install the end bushing removing adapter on the inboard side of the beam end bushing. Check that the cone-shaped surface of the adapter is facing the equalizer beam.

   IMPORTANT: Align the receiving tube so that the bushing will clear the edges of the tube when force is exerted against the beam. Align the removing adapter so that force is exerted only on the bushing to ensure a clean pull through the beam.
   - 3.4 Install the hexnut on the pulling screw. Full thread engagement is needed.
   - 3.5 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.
   - 3.6 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely remove the end bushing.

NOTE: If the pressure gauge on the hydraulic pumping unit reads 68 950 kPa (10,000 psi) and the bushing has not broken loose, stop and check the alignment of the receiving tool and removal adapter. If both tools are aligned correctly, attach a sledging adapter on the speed nut end of the pulling screw. Maintaining hydraulic pressure, strike the sledging adapter with a heavy hammer. A loud noise followed by a sudden drop of the pressure gauge reading indicates the bushing has broken loose.

4. Remove the beam end bushings (if using shop-made adapters).
   - 4.1 Remove the equalizer beams. For instructions, **refer to Subject 130.**
   - 4.2 Position the equalizer beam on a 50-ton vertical hydraulic press.
   - 4.3 Center the shop-made adapter (refer to the table of special tools in **"Specifications,**

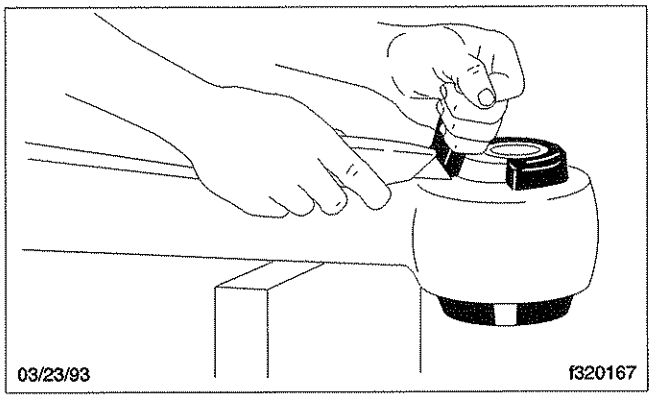


Fig. 1

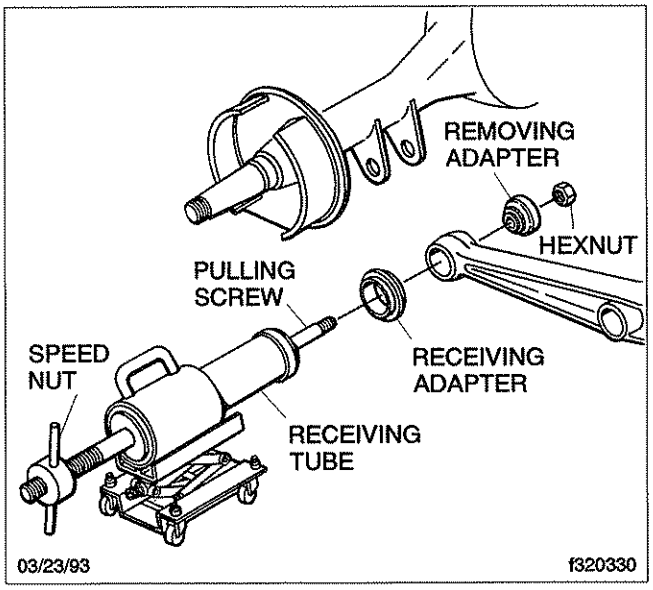


Fig. 2

Equalizer Beam End Bushing Removal and Installation

400") on the trimmed end of the equalizer beam bushing. Press the end bushing from the beam eye.

Installation

1. Using emery cloth, remove all scale, rust, or corrosion from the beam eyes. Inspect the equalizer beam eyes for cracks, gouges, or damage. Replace the equalizer beam if any of these conditions exist.
2. Using emery cloth, clean the outer sleeves of the new equalizer beam end bushings. Apply a thin coating of Texaco Compound L, or an equivalent rust preventive lubricant, to the surface of the outer sleeves on the new bushing.
3. Install the beam end bushings, (if using Owatonna tools, refer to **Fig. 3**):
   - 3.1 Fit the adapter clamp over the exposed rubber on the new bushing. Tighten the clamp nuts until the clamp is flush against the bushing outer sleeve.
   - 3.2 Install the receiving adapter on the receiving tube.
   - 3.3 Position the hydraulic ram and slide the pulling screw through the end bushing.
   - 3.4 Center the adapter clamp and bushing on the inboard side of the beam end.
   - 3.5 Install the adapter plate and secure it with the hexnut.

   IMPORTANT: Check that the new bushing and the installation tools are centered so that the bushing will clear the receiving tube when force is exerted against the beam.
   - 3.6 Tighten the speed nut and remove any slack in the assembly.
   - 3.7 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.
   - 3.8 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely install the end bushing.

   NOTE: The pressure gauge on the pumping unit should read 27 580 to 37 920 kPa (4000 to 5500 psi) during installation. If the reading reaches the operating limit of 68 950 kPa (10,000 psi) and the bushing is not going into the beam end, check the alignment of the bushing, tooling, and hydraulic equipment. Installation is complete when the adapter clamp is flush against the beam.
   - 3.9 Install the equalizer beam ends on the axle beam hangers. For instructions, **refer to Subject 130.**
4. Install the beam end bushings (if using shop-made adapters, see **Fig. 4**).
   - 4.1 Position the equalizer beam on a 50-ton hydraulic press.
   - 4.2 Using a sheave puller, compress the exposed rubber of the bushing until the puller jaws are flush against the end of the bushing outer sleeve.
   - 4.3 Position the shop-made adapter (refer to the table in **"Specifications, 400"**) against the jaws of the sheave puller. Press the new bushing into the beam eye.
   - 4.4 Install the equalizer beam. For instructions, **refer to Subject 130.**

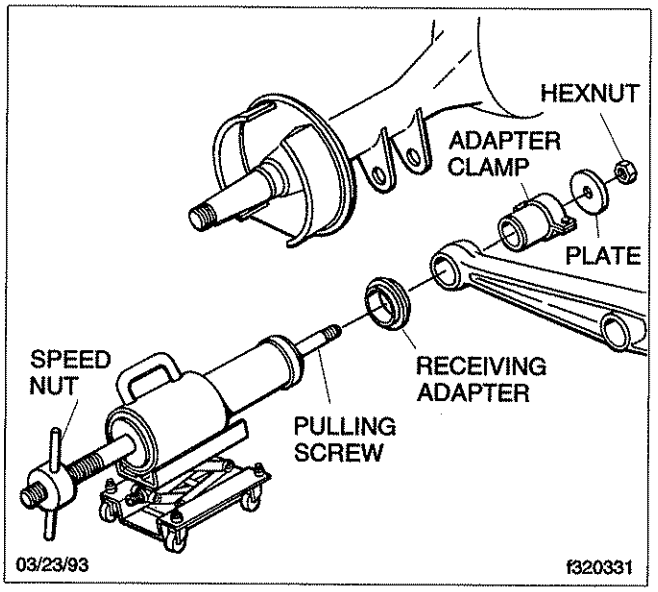


Fig. 3

Equalizer Beam End Bushing Removal and Installation

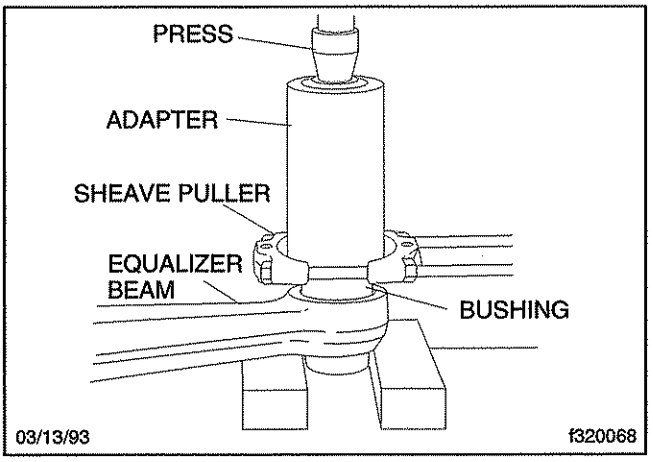


Fig. 4

Equalizer Beam Bar Pin/Bushing Assembly Removal, Installation, and Alignment

Removal

NOTE: From July 1995, most Hendrickson suspensions are manufactured with a bar pin-type bushing assembly that connects the equalizer beam to the axle. The bar pin/bushing assembly can be serviced without removing the brake assembly.

⚠ WARNING

Do not use a cutting torch to remove the equalizer beams from the beam hangers. The equalizer beams are heat-treated, and using a cutting torch could weaken them. This could result in a loss of vehicle control, possible personal injury, or property damage.

1. Shut down the engine and set the parking brake.
2. Chock the front tires.
3. Support the equalizer beams with jack stands.
4. Remove the four bolts attaching the equalizer beam to the saddle.
5. Apply a penetrating oil to the threads of the two 1-inch (25 mm) bolts and locknuts attaching each bar pin/bushing assembly to the axle brackets.
6. Remove the bolts. If the fasteners are rusted in place, an air hammer chisel may be used to loosen the bolts attaching the bar pin/bushing assembly to the axle brackets.

NOTE: The upper torque rods may have to be disconnected at the top of the axle, and the axle rotated to a more vertical position to assist in the removal of the equalizer beam from the axle bracket.

7. Remove the equalizer beam from the axle beam hangers.
8. The bar pin/bushing assemblies can be removed from the equalizer beams with Owatonna tools. To do so, follow Owatonna recommendations.
9. If shop-made tools are used, remove the bar pin/bushing assemblies from the beam ends as follows:

   9.1 Position the equalizer beam on a 50-ton vertical hydraulic press.

   9.2 Center the shop-made tool, and press the bar pin/bushing assembly from the beam end eye.

Installation

IMPORTANT: Do not reuse the old fasteners. Replace them during installation.

1. Using emery cloth, remove all scale, rust, or corrosion from the beam eyes. Inspect the equalizer beam eyes for cracks, gouges, or damage. Replace the equalizer beam if any of these conditions exist.
2. The outer metals of some Hendrickson rubber bushings are covered with a phosphate coating that acts as a rust preventive. This coating must be removed with emery cloth before installation. Also apply a coating of grease to the cleaned outer metals of the bar pin/bushing assembly, and to the beam end eyes to help when pressing the bar pin/bushing assembly into the beam end eye.
3. If using Owatonna tools, install the bar pin/bushing assemblies using Owatonna recommendations.
4. If using shop-made tools, create the needed assembly tool from a 5-inch (127 mm) length of 5-inch (127 mm) O.D. steel tubing with 1/2-inch (13 mm) wall thickness. See **Fig. 1**. The assembly tool must be split in half, then clamped or bolted together to compress the rubber to allow contact with the bushing outer metal.

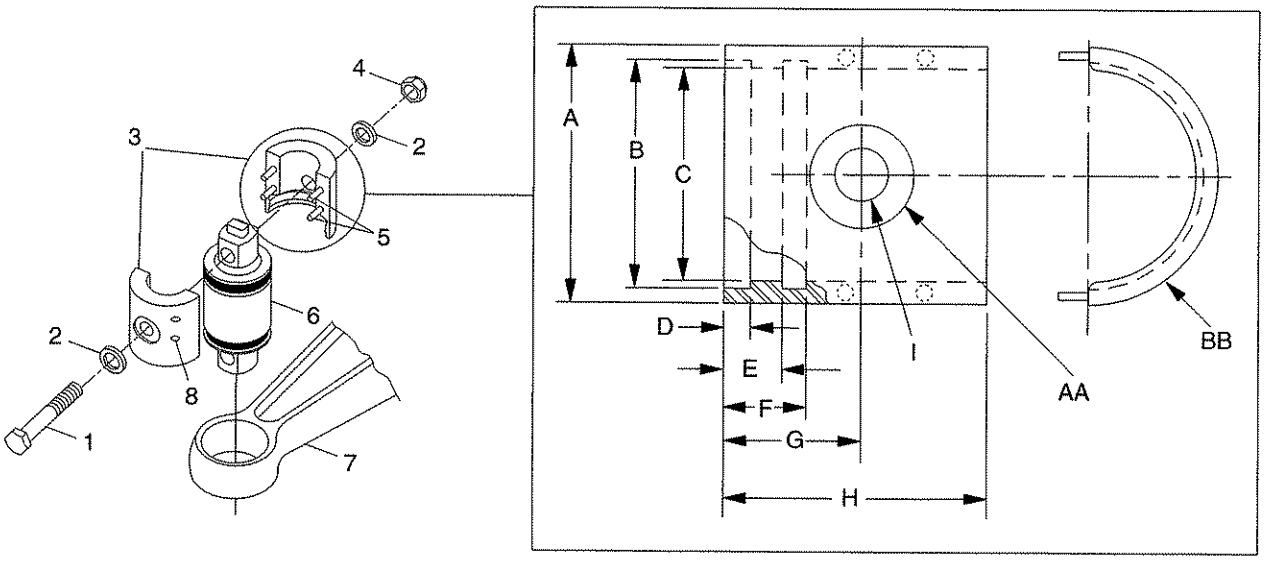
   4.1 Position the equalizer beam on a 50-ton hydraulic press with the beam end bore squarely supported on the bed for safety and to avoid bending the equalizer beam.

   4.2 Before pressing the bar pin/bushing assembly, align the holes in the end of the bar pin/bushing assembly with the center line of the equalizer beam. This will help assembly into the axle brackets. Care should be taken during the assembly process to ensure the orientation of the bar pin/bushing assembly in the beam eye.

   NOTE: After installation, verify that the bar pin/bushing assembly is centered in the end of the beam.

5. Install the equalizer beam on the axle hangers.

Equalizer Beam Bar Pin/Bushing Assembly Removal, Installation, and Alignment



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1. Bolt, 1" (25 mm)
2. Washer, 1" (25 mm) o.d.
3. Assembly Tool
4. Locknut
5. Alignment Pins
6. Bar Pin/Bushing Assembly
7. Equalizer Beam
8. Alignment Pin Hole

A. 5.0" (127 mm)
B. 4.43" (113 mm)
C. 4.12" (105 mm)
D. 0.50" (13 mm)
E. 1.07" (27 mm)
F. 1.54" (39 mm)
G. 2.62" (67 mm)
H. 5.0" (127 mm)
I. 1.0" (25 mm)

AA. Recess flat counter bore, 2.0" (51 mm) x 0.25" (6 mm) deep.
BB. Tool wall, 0.50" (13 mm), top view.

NOTE: The material used to make the tool is: 0.50" (13 mm) wall x 5.0" (127 mm) o.d. x 5.0" (127 mm) long steel tubing.
IMPORTANT: The assembly tool must be split in half as shown.

Fig. 1, Assembly Tool (exploded view, with manufacturing information)

6. Attach the bar pin/bushing assembly to the axle brackets. Tighten the 1-inch (25 mm) bolts 450 to 600 lbf·ft (610 to 813 N·m).

NOTE: Bar pin/bushing assembly kits are available with or without alignment shims.

7. Install the four bolts attaching the equalizer beam to the saddle. Tighten 225 to 275 lbf·ft (305 to 375 N·m).
8. Remove the jack stands.
9. Remove the chocks from the tires.

Alignment

For a detailed adjustment procedure, refer to Hendrickson's service literature, **Bar Pin Alignment Instructions, Technical Publication No. 17730-213**.

The instruction publication may be obtained from:

Hendrickson Truck Suspension Systems
1-630-910-2800
1-800-973-0360
(fax) 1-630-378-4849
800 South Frontage Road
Woodridge, IL 60517-4904

Equalizer Beam Rubber Center Bushing Removal and Installation

Removal

NOTE: If using Owatonna tools, removal of the equalizer beam is not required for removal or installation of the rubber center bushing.

1. Chock the front tires.
2. Raise the rear of the vehicle so that all weight is removed from the suspension. Block the axles and the frame with safety stands. Make sure the stands will securely support the weight of the axles and the frame.

NOTE: Do not raise the vehicle to the point where the weight of the suspension and axles hangs from the vehicle.

3. Remove the saddle cap nuts and washers from each side of the vehicle, and remove the saddle caps.
4. Raise the rear of the truck frame until the saddle studs clear the equalizer beam. Install safety stands under the frame.
5. Using a 2-1/2 inch diameter hole saw **(see Fig. 1),** cut out the end plug from the center bushing on each side of the suspension, and remove the crosstube.

⚠ CAUTION

CAUTION: Do not use a cutting torch to burn out the end plugs. The equalizer beams are heat treated, and the use of a cutting torch could weaken the beam.

6. On the inboard side of the equalizer beam, inspect the exposed edge of the bushing's outer sleeve.
7. Chisel or grind off any portion of the outer sleeve that has flared over the surface of the equalizer beam.
8. Remove the rubber center bushings (if using Owatonna tools, refer to **Fig. 2**).

   8.1 Position the hydraulic ram and slide the pulling screw through the center bushing.

   8.2 Install the center bushing removing adapter on the inboard side of the beam eye.

   IMPORTANT: Align the receiving tube so that the bushing will clear the edges of the tube when force is exerted against the beam. Align the removing adapter so that force is exerted only on the bushing to ensure a clean pull through the beam.

   8.3 Install the hexnut on the pulling screw. Full thread engagement is needed.

   8.4 Install spacers between the ram cylinder and the speed nut. Tighten the speed nut and remove any slack in the assembly.

   8.5 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.

   8.6 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely remove the bushing.

   NOTE: If the pressure gauge on the hydraulic pumping unit reads 68 950 kPa (10,000 psi) and the bushing has not broken loose, stop and check the alignment of the receiving tool and removal adapter. If both tools are aligned correctly, attach a sledging adapter on the speed nut end of the pulling screw. Maintaining hydraulic pressure, strike the sledging adapter with a heavy hammer. A loud noise followed by a sudden drop of the pressure gauge reading indicate that the bushing has broken loose.

9. If using shop-made adapters, remove the equalizer beams. For instructions, **refer to Subject 130.**

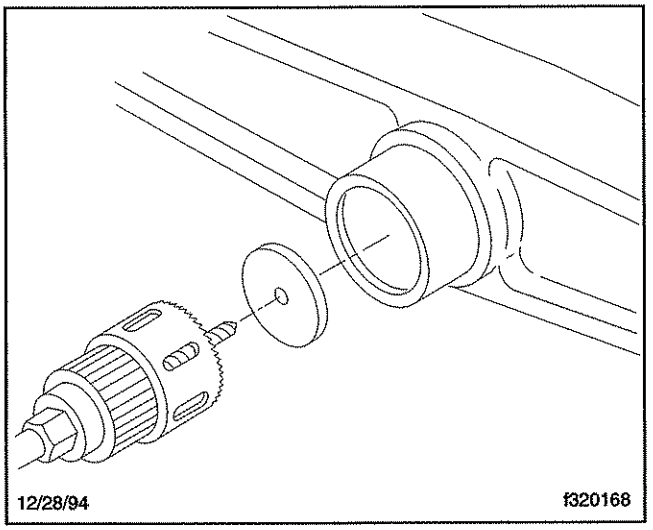


Fig. 1

Equalizer Beam Rubber Center Bushing Removal and Installation

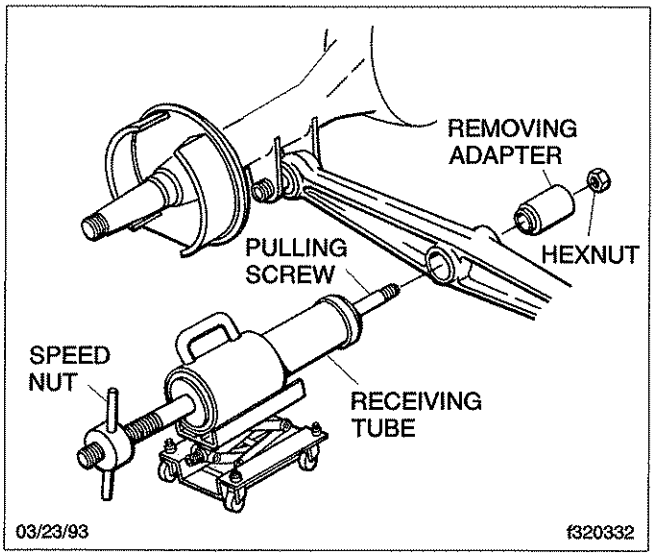


Fig. 2

9.1 Position the equalizer beam on a 50-ton vertical hydraulic press.

9.2 Center the shop-made adapter (refer to the table in **"Specifications, 400"**) on the trimmed end of the equalizer beam bushing. Press the center bushing from the beam eye.

Installation

1. Using emery cloth, remove all scale, rust, or corrosion from the beam eyes. Inspect the equalizer beam eyes for cracks, gouges, or damage. Replace the equalizer beam if any of these conditions exist.
2. Using emery cloth, clean the outer sleeves of the new equalizer beam center bushings. Apply a thin coating of Texaco Compound L, or an equivalent rust preventive lubricant, to the surface of the outer sleeves on the new bushing.
3. Install the rubber center bushings (if using Owatonna tools, refer to **Fig. 3**).

3.1 Center the hydraulic ram and slide the pulling screw through the beam eye.

3.2 Position the bushing on the inboard side of the beam eye.

IMPORTANT: Center the new bushing to ensure a clean pull through the beam eye.

3.3 Fit the installing adapter over the inner sleeve and against the outer sleeve of the bushing.

3.4 Install the hexnut on the pulling screw. Full thread engagement is needed.

3.5 Install spacers between the ram cylinder and the speed nut. Tighten the speed nut and remove any slack in the assembly.

3.6 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.

3.7 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely install the center bushing.

NOTE: The pressure gauge on the pumping unit should read 27 580 to 37 920 kPa (4000 to 5500 psi) during installation. If the reading reaches the operating limit of 68 950 kPa (10,000 psi) and the bushing is not going into the beam, check the alignment of the bushing, tooling, and hydraulic equipment. Installation is complete when the installing adapter is flush against the beam.

3.8 Position the crosstube in the center bushings.

⚠ WARNING

WARNING: Wear protective welding masks and gloves when welding. Failure to do so could result in personal injury due to the intensity of heat, sparks, and flying debris from the welding process.

3.9 Arc weld new end plugs to the tire side of each center bushing inner sleeve.

NOTE: Heat from welding the end plugs will not affect the beam or the new rubber bushings because of their distance from the point of welding.

4. Position the saddle caps on the saddle cap studs, then install the washers and new self-locking nuts. Tighten the nuts to the applicable torque in **"Specifications, 400."**

Equalizer Beam Rubber Center Bushing Removal and Installation

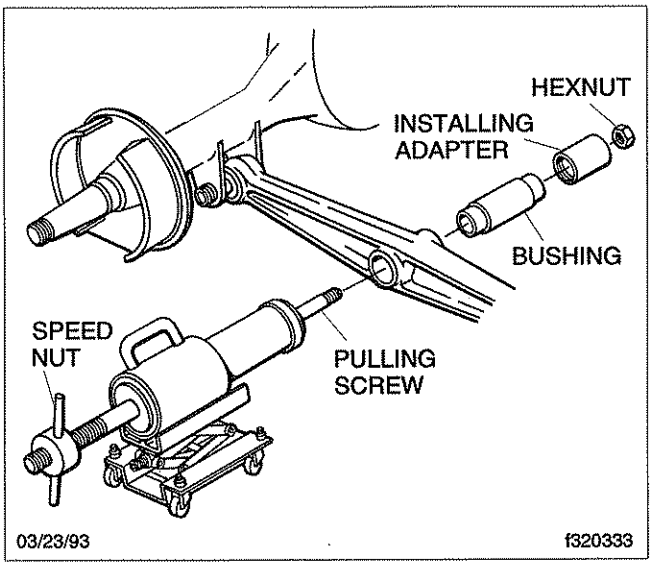


Fig. 3

5. If using shop-made adapters, position the equalizer beam on a 50-ton hydraulic press.

   5.1 Using standard center bushings with the end plugs welded in place, position the shop-made adapter (refer to the table in **"Specifications, 400"**) over the inner sleeve of the bushing. Check that the adapter bottoms against the bushing outer sleeve, then press the new bushing into the beam eye.

   5.2 Install the equalizer beams. For instructions, **refer to Subject 130.**

Equalizer Beam Bronze Center Bushing Removal and Installation

Removal

NOTE: If using Owatonna tools, you can remove or install the bronze center bushing without removing the equalizer beam.

1. Chock the front tires.
2. Raise the rear of the vehicle so that all weight is removed from the suspension. Block the axles and the frame with safety stands. Make sure the stands will securely support the weight of the axles and the frame.

NOTE: Do not raise the vehicle to the point where the weight of the suspension and axles hangs from the vehicle.

3. Remove the saddle cap nut and washers from each side of the suspension, and remove the saddle caps.
4. Raise the rear of the truck frame until the saddle studs clear the equalizer beam. Install safety stands under the frame.
5. Using a 2-1/2 inch diameter hole saw, cut out the retaining disk from the center bushing on each side of the suspension, and remove the crosstube.

⚠ CAUTION

CAUTION: Do not use a cutting torch to burn out the retaining disk. The equalizer beams are heat treated, and the use of a cutting torch could weaken the beam.

6. Remove the bronze center bushing (if using Owatonna tools, refer to **Fig. 1**).
   - 6.1 Position the hydraulic ram and slide the pulling screw through the center bushing.
   - 6.2 Install the center bushing removing adapter on the inboard side of the beam eye.

   IMPORTANT: Align the receiving tube so that the bushing will clear the edges of the tube when force is exerted against the beam. Align the removing adapter so that force is exerted only on the bushing to ensure a clean pull through the beam.

   - 6.3 Install the hexnut on the pulling screw. Full thread engagement is needed.
   - 6.4 Install spacers between the ram cylinder and the speed nut. Tighten the speed nut and remove any slack in the assembly.
   - 6.5 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.
   - 6.6 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely remove the center bushing.

   NOTE: If the pressure gauge on the hydraulic pumping unit reads 68 950 kPa (10,000 psi) and the bushing has not broken loose, stop and check the alignment of the receiving tool and removal adapter. If both tools are aligned correctly, attach a sledging adapter on the speed nut end of the pulling screw. Maintaining hydraulic pressure, strike the sledging adapter with a heavy hammer. A loud noise followed by a sudden drop of the pressure gauge reading indicates that the bushing has broken loose.

7. If using shop-made adapters, remove the equalizer beams. For instructions, **refer to Subject 130.**
   - 7.1 Position the equalizer beam on a 50-ton vertical hydraulic press.
   - 7.2 Center the shop-made adapter (refer to the table in **"Specifications, 400"**) on the

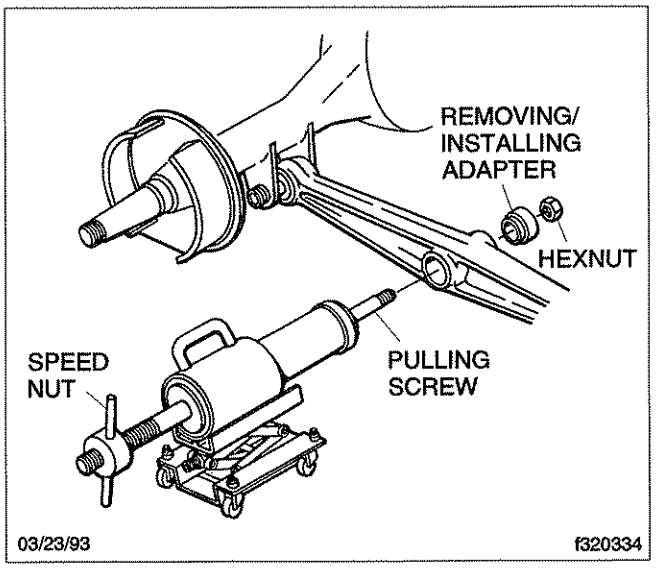


Fig. 1

Equalizer Beam Bronze Center Bushing Removal and Installation

center bushing. Press the bushing from the beam eye.

Installation

1. Using emery cloth, remove all scale, rust, or corrosion from the beam eyes. Inspect the equalizer beam eyes for cracks, gouges, or damage. Replace the equalizer beam if any of these conditions exist.
2. Using emery cloth, clean the outer sleeves of the new equalizer beam center bushings. Apply a thin coating of Texaco Compound L, or an equivalent rust preventive lubricant, to the surface of the outer sleeves on the new bushing, and to the inside surface of the beam eye.
3. Position the bushing on the equalizer beam eye.
4. Install the bronze center bushings (if using Owatonna tools, refer to **Fig. 2**):
   - 4.1 Center the hydraulic ram and slide the pulling screw through the beam eye.
   - 4.2 Position the bushing on the inboard side of the beam eye. Check that the grooves of the bushing are aligned with the vertical centerline of the equalizer beam **(see Fig. 3).**
   - 4.3 Fit the installing adapter and the removing/installing adapter against the outer sleeve of the bushing. Make sure the deep ridge on the installing adapter is positioned against the bronze bushing **(see Fig. 4).**
   - 4.4 Install the hexnut on the pulling screw. Full thread engagement is needed.
   - 4.5 Install spacers between the ram cylinder and the speed nut. Tighten the speed nut and remove any slack in the assembly.

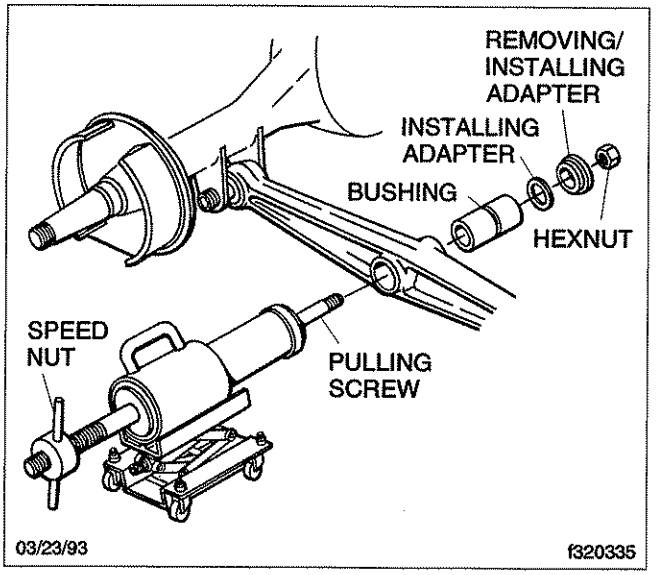


Fig. 2

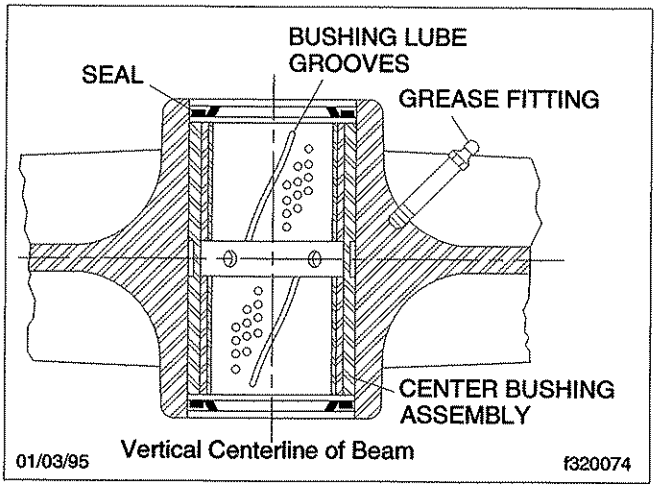


Fig. 3

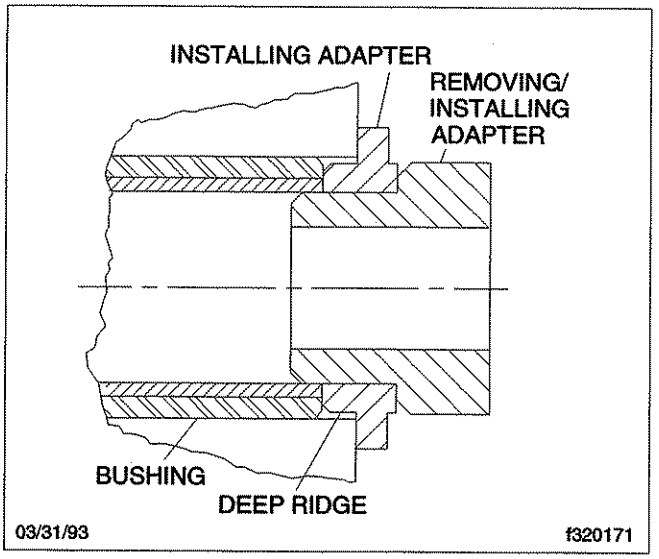


Fig. 4

4.6 Connect a hydraulic pumping unit to the ram and apply force until the ram cylinder reaches its stroke limit.

4.7 Release the pressure, add spacers, and tighten the speed nut. About three adjustments are needed to completely install the center bushing.

NOTE: The pressure gauge on the pumping unit should read 27 580 to 37 920 kPa (4000 to 5500 psi) during installation. If the reading reaches the operating limit of 68 950 kPa (10,000 psi) and the bushing is not going into the beam, check the alignment of the bushing, tooling, and hydraulic equipment. Installation is complete when the installing adapter is flush against the beam.

4.8 On the inboard side of the beam, position a grease seal and installing adapter against the center bushing. Make sure the shallow end of the adapter is against the grease seal **(see Fig. 5).** Using a hammer, tap the installing adapter until it is flat against the beam. Using the same procedure, install a grease seal on the outboard side of the beam.

5. If using shop-made adapters, position the equalizer beam on a 50-ton hydraulic press.

5.1 Center the new bushing in the beam eye. Using a standard bushing driver, press the bushing in until there is equal spacing between both bushing ends and the sides of the beam eye.

5.2 Install the new grease seals (with the seal lips facing out).

NOTE: Check that the new seals are 1/6 inch (4 mm) inside the beam hub surface to ensure clearance and protection of the seals when the saddle cap is installed.

6. Apply a thin coating of multipurpose chassis grease to the inside surface of the center bushing. Slide the bushing center sleeve into the bushing.

7. Install the grease fitting into the beam hub. Rotate the center sleeve and apply multipurpose chassis grease in the grease fitting. Lubricate until clean grease appears at both ends of the grease seals.

8. Install the crosstube.

9. Install the saddle caps or the equalizer beam (if removed) on the axle beam hangers. For instructions, **refer to Subject 130.**

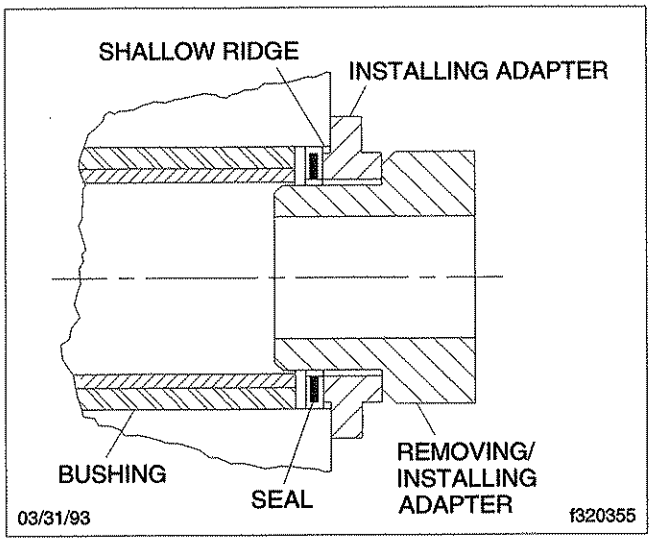


Fig. 5

Torque Rod Removal, Bushing Replacement, and Installation

Removal

IMPORTANT: To ensure that the required tools are available, see the table of special tools in **"Specifications, 400,"** before beginning these procedures. Special tools are available from the Owatonna Tool Company, Owatonna, Minnesota, or an affiliated dealer.

⚠ WARNING

WARNING: When the torque rods are disconnected from the axle brackets, the axles become free to pivot on the equalizer beam end bushings. Keep clear of the beam hangers and beam ends to avoid possible injury.

1. On fore-and-aft torque rods, remove the bolts and nuts from the torque rod axle brackets, and the crossmember mounting brackets **(see Fig. 1).** Remove the torque rods.

   On transverse torque rods, remove the nuts and washers from the axle brackets, and remove the bolts and nuts from the frame rail mounting brackets **(see Fig. 1).** Remove the torque rods.

NOTE: If necessary, use an impact hammer and tap the top of the axle bracket to disengage the rod stud from the axle bracket.

2. Inspect the torque rods. If bent or cracked, replace. Check the torque rod bushings. If one of the bushings is loose or damaged, replace both of the bushings.
3. Position the press plate on the hydraulic press. Check that the small counterbore of the plate hole is facing up.

NOTE: Some tapered stud torque rod bushings have a large non-removable washer on the stud that will not fit though the press plate hole. Loosen the press plate capscrews and separate the halves **(see Fig. 2)** until the washer clears the counterbore, and the torque rod sets on the press plate. Tighten the capscrews until the press plate halves are closed.

4. Position the tapered stud removal tool (using the end with the larger inside diameter) on the torque rod stud. Apply lubricating oil **(see Fig. 3),** then press the stud out of the bushing.
5. Position the bushing remover/replacer tool (using the end with the larger outside diameter) on the bushing. Install the cap, then apply lubricating oil to the torque rod bushing.
6. Press the rubber bushing out of the torque rod eye.
7. Position the straddle mount end of the torque rod into the hole of the press plate. Tighten the press plate capscrews.
8. Position the straddle mount pin remover on the straddle mount pin **(see Fig. 4).**
9. Apply lubricating oil to the straddle mount pin. Press the straddle mount pin out of the bushing.
10. Position the end of the rubber bushing remover/replacer tool (using the end that has the larger outside diameter) on the bushing. Install the cap, then apply lubricating oil to the torque rod bushing.
11. Press the rubber bushing out of the torque rod eye.

Installation

1. Remove all dirt and grease from the torque rod ends. Apply lubricant on the new bushings and in the torque rod eyes.
2. Position the press plate on the hydraulic press. Check that the small counterbore of the plate hole is facing up.
3. Position the new bushing on the tapered stud of transverse torque rods. Position the clamp and tighten it to compress the rubber **(see Fig. 5).**
4. Place the torque rod end, the bushing, and the clamp on the press plate.
5. Place the remover/replacer tool **(see Fig. 6)** and cap on top of the clamping tool and press the bushing in the torque rod end. Check that the bushing sleeve protrudes equally on each side of the torque rod end.
6. On straddle mount end assemblies, align the clamping tool on the bushing **as shown in Fig. 7.** Tighten the clamp to compress the rubber of the new straddle mount bushing.

NOTE: When tightening the clamp, make sure that the position of the bushing pin is at a right angle to the center line of the torque rod shank **(see Fig. 8).**

Torque Rod Removal, Bushing Replacement, and Installation

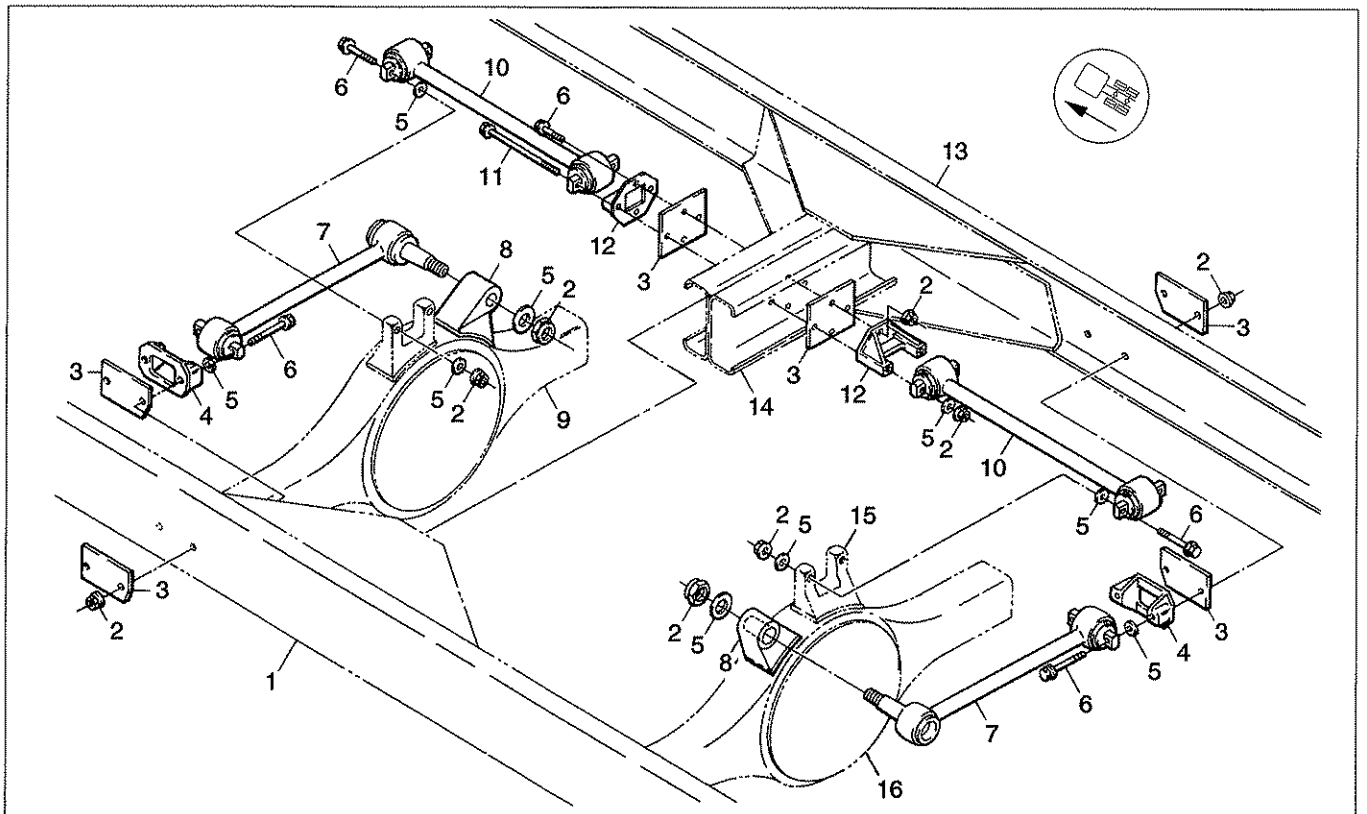


Fig. 1, Torque Rod Mounting Assembly

7. Place the torque rod end, the bushing, and the clamp on the press plate.
8. Using the larger end of the remover/ replacer tool, position the tool and cap on top of the clamp assembly.
9. Press the bushing in the torque rod end. Check that the bushing's outer sleeve protrudes equally on each side of the torque rod end.
10. Install the fore-and-aft torque rods **(refer to Fig. 1).**

10.1 Position a torque rod straddle mount pin in the forward-rear axle bracket. Install the bolts through the axle bracket and the straddle mount pin. Install a spacer and nut on each bolt, and tighten the nut 260 N·m (190 lbf·ft).

10.2 Position a torque rod straddle mount pin in the rearmost axle bracket. Install the flanged bolts through the axle bracket and the straddle mount pin. Install a spacer and

Torque Rod Removal, Bushing Replacement, and Installation

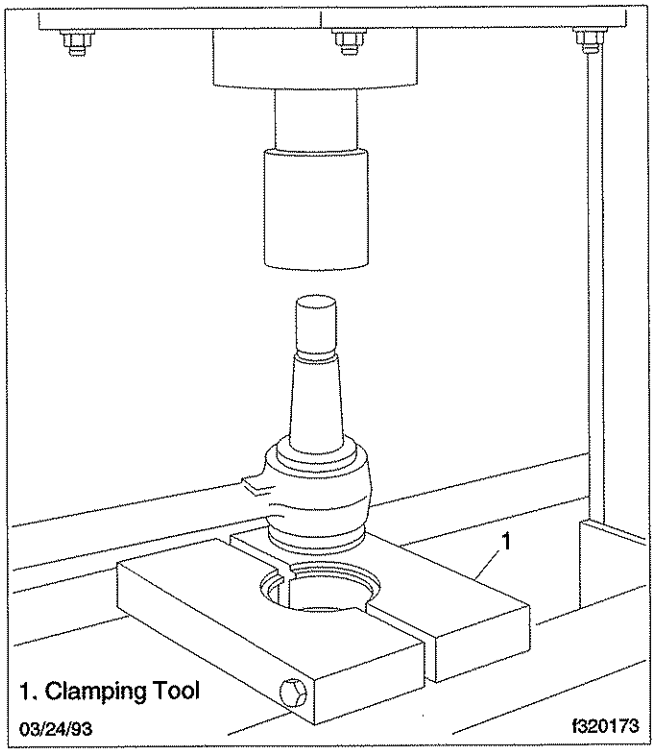


Fig. 2

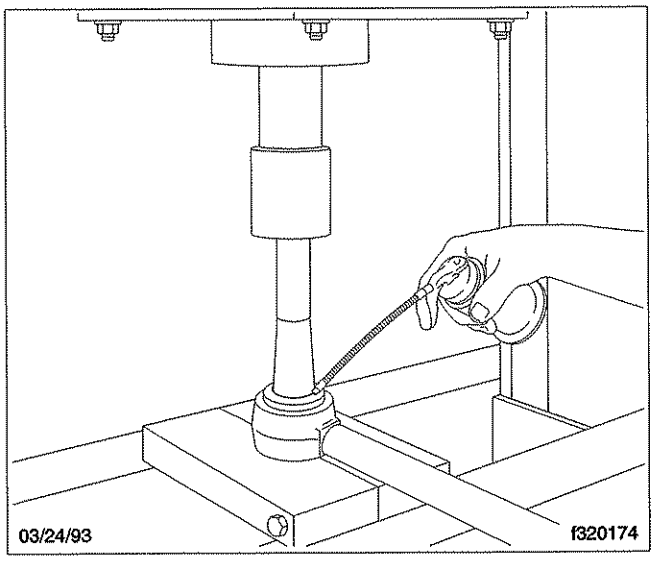


Fig. 3

nut on each bolt, and tighten the nut 260 N·m (190 lbf·ft).

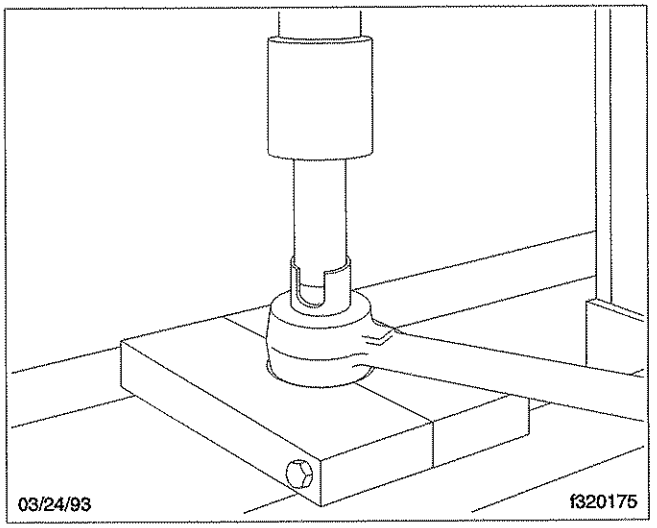


Fig. 4

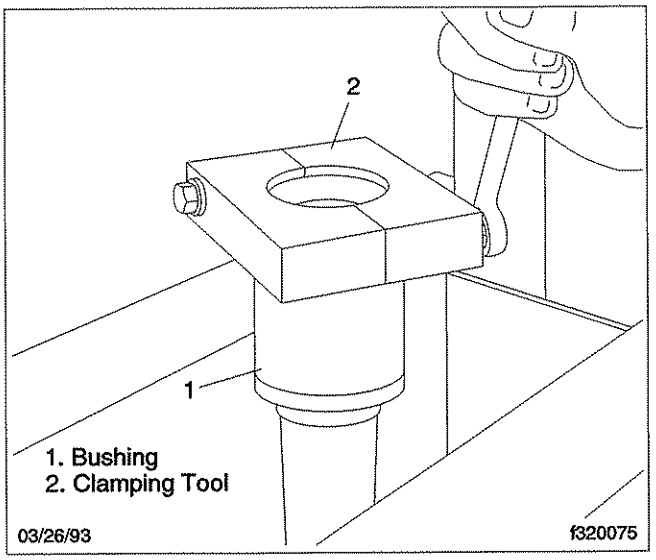


Fig. 5

10.3 Position a torque rod spacer and straddle mount bracket on each side of the cross-member. Insert bolts through the upper and lower holes of the forward mounting bracket. Install the nuts and tighten them 130 N·m (95 lbf·ft).

10.4 Position the straddle mount pin of the forward torque rod in the mounting bracket. Insert bolts through the forward pin, both bracket assemblies, and the straddle mount pin of the rear torque rod. Install the nuts

Torque Rod Removal, Bushing Replacement, and Installation

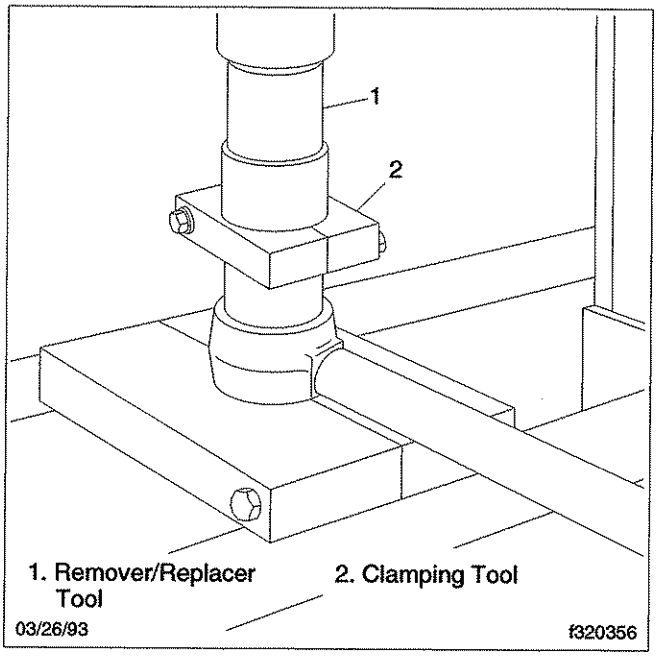


Fig. 6

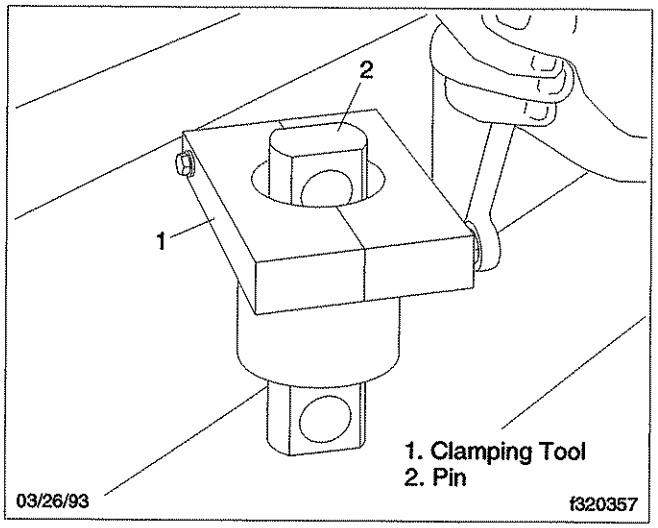


Fig. 7

and bearing washers. Tighten the nuts 260 N·m (190 lbf·ft).

11. Install the transverse torque rods **(refer to Fig. 1).**

    11.1 Check that the tapered stud end and the tapered stud bracket hole are clean. Lubricate the tapered stud ends with SAE 20 oil.

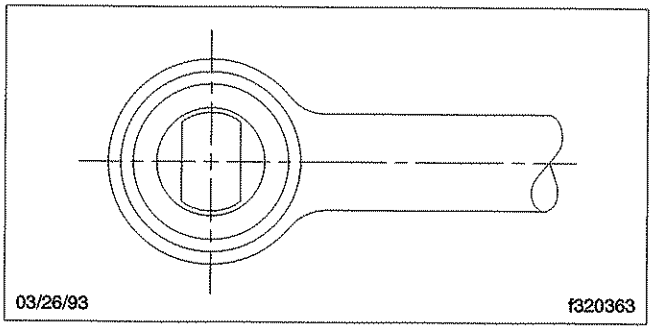


Fig. 8

    11.2 Install the tapered stud in the axle bracket. Install a washer and nut. Tighten the nut 235 to 305 N·m (175 to 225 lbf·ft).

    11.3 Align the straddle mount end, the mounting bracket, and the spacer against the inside frame rail.

    11.4 On the inboard side of the frame rail, install the bolts through the mounting assembly and the frame rail.

    11.5 On the outboard side of the frame rail, install a spacer over the mounting bolt studs. Install the nuts and tighten them 260 N·m (190 lbf·ft).

12. Check the axle pinion angle. For instructions, **refer to the driveline components group.**

Specifications

Torque Values		
Description	**Size**	**Torque lbf.ft (N.m)**
Top Pad to Spring Aligning Setscrew (RT/RTE)	—	135–200 (100–150)
Top Pad Nut (RT/RTE)	—	275–400 (375–542)
U-Bolt High Nuts (U/UE)	7/8–14	Stage 1: Hand tighten
		Stage 2: 60 (81)*
		Stage 3: 200 (271)*
		Stage 4: 420 to 500 (571 to 680)*
Spring Pin Locknut	1/2–13	45–63 (61–85)
Torque Rod Straddle Mount Nut	5/8–11	190 (260)
Torque Rod Stud Locknut	1-1/4–12	175–225 (235–305)
Saddle Cap Stud	7/8–14	55–65 (75–90)
	3/4–16	
Saddle Cap Locknut: RT/RTE	7/8–14	225–275 (305–373)
Saddle Cap Locknut: U/UE	3/4–16	125–145 (169–197)
Adapter-Type Beam End Locknut	3/4–16	210–240 (285–325)
Spring Center Bolt	7/16–20	50–60 (70–80)
	1/2–20	90–100 (65–75)
	1/2–13	
Rebound Spacer Locknut	1/2–13	38–45 (51–61)
Spring Alignment Clip	—	15 (20)
Fore and Aft Torque Rod Mount Nut	—	95 (130)

* Tighten in a diagonal pattern as shown in **Fig. 1.**

Table 1, Torque Values

Shop-Made Adapters		
Tool Number	**Dimensions**	**Usage**
1	4-1/4 inch o.d. by 4 inch	Beam End Bushing Removal
2	4-1/2 inch o.d. by 4 inch	Beam End Bushing Installation
3	4-5/8 inch o.d. by 7 inch	Beam Center Bushing Removal and Installation

Table 2, Shop-Made Adapters

Special Tools (Owatonna Tool Company)		
Part Number	**Tool**	**Usage**
1745	Adapter Puller Set	Adapter-Type End Support Removal
1761	Torque Rod Set	Torque Rod Bushing Removal and Installation
28536	Installing Adapter (5-3/4" o.d.)	Bronze Center Bushing and Seal Removal and Installation
44119	Receiving Tube	Center and End Bushing Removal and Installation

Specifications

Special Tools (Owatonna Tool Company)		
Part Number	**Tool**	**Usage**
45052	Adapter Clamp	End Bushing Installation
51678	80-Ton Hydraulic Ram	All Operations
51695	Jack	All Operations
206459	Plate	End Bushing Installation
302018	Spacer (3 qty.)	Center and End Bushing Removal and Installation
302019	Receiving Adapter	End Bushing Removal and Installation
302023	Pulling Screw	All Operations
302024	Removing and Installing Adapter	Bronze Center Bushing Removal and Installation
302026	Installing Adapter	Rubber Center Bushing Removal and Installation
302027	Removing Adapter	Rubber Center Bushing Removal and Installation
302028	Hexnut	All Operations
302029	Speed Nut	All Operations
302030	Removing Adapter	End Bushing Removal and Installation

Table 3, Special Tools (Owatonna Tool Company)

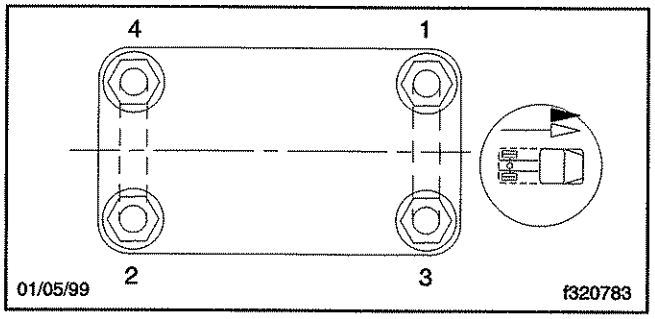


Fig. 1, Tightening Pattern for U-bolt High Nuts

Rear Spring Suspension, Tandem Axle 32.05

Contents

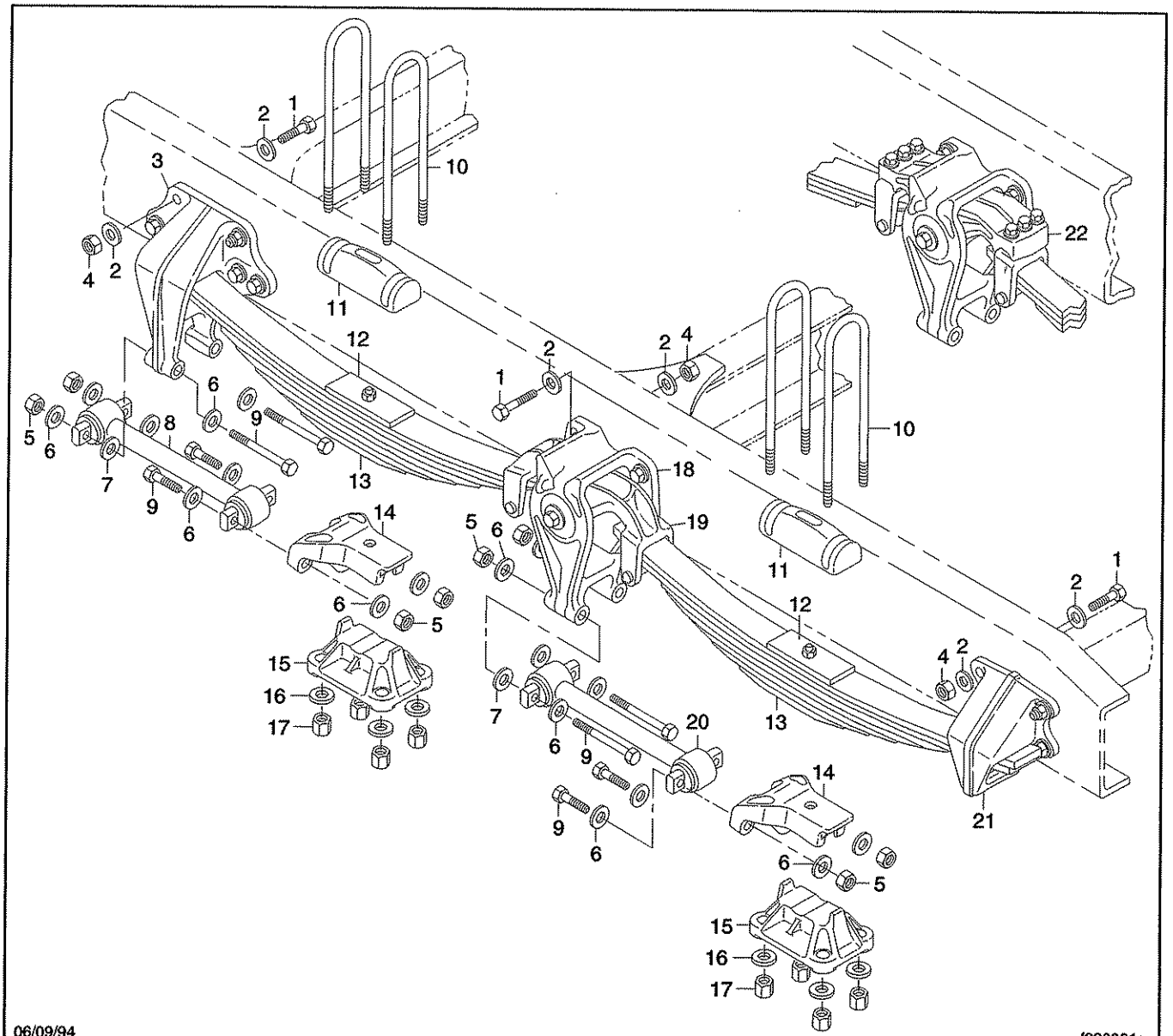
Subject	Subject Number
General Description	050
Service Operations	
Radius Rod Removal and Installation	100
Equalizer Removal, Inspection, and Installation	110
Spring Assembly Replacement	120
Spring Bracket and Equalizer Bracket Replacement	130
Rear Axle Alignment Adjustment	140
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General Description

The tandem-axle rear spring suspension **(Fig. 1)** uses a six-point equalizing leaf spring design, which compensates for axle articulation, from side to side, and front to rear. Four semi-elliptical spring assemblies are attached to the axles with U-bolts. On both sides of the vehicle, the forward end of the forward spring and the rear end of the rear spring ride in aluminum brackets that are mounted on the frame rails. Steel wear shoes are cast into each bracket.

At the center, between the forward and rear springs, the springs ride on an equalizer, which pivots on a sleeve in the equalizer bracket. Equalizer travel is stopped when the top of the equalizer and the equalizer bracket make contact. Each axle is held in alignment by a pair of radius rods that extend forward from the axle seats to the forward spring brackets for the forward-rear axle, and to the equalizer brackets for the rearmost axle.

General Description



1. Suspension Bracket Hexbolt
2. Hardened Washer
3. Forward Spring Bracket
4. Suspension Bracket Hex Locknut
5. Radius Rod Hex Locknut
6. Hardened Washer
7. Axle Alignment Washer
8. Forward Radius Rod
9. Radius Rod Hexbolt
10. U-Bolt
11. U-Bolt Pad
12. Spring Liner
13. Leaf Spring Assembly
14. Spring Seat
15. U-Bolt Retainer
16. Hardened Washer
17. U-Bolt High Nut
18. Equalizer Bracket
19. Equalizer, One-Piece (tandem drive axles)
20. Rear Radius Rod
21. Rear Spring Bracket
22. Equalizer, Three-Piece (tag or pusher axle)

Fig. 1, Tandem-Axle Spring Suspension

Radius Rod Removal and Installation

Removal (See Fig. 1)

1. Apply the parking brakes, and chock the tires.
2. Note the number of axle alignment washers (Ref. 4) at the forward end of each radius rod that is being removed.
3. Remove the fasteners that attach the radius rod to the forward spring bracket or equalizer bracket, and to the axle seat.
4. Remove the radius rod and any axle alignment washers.

Installation (See Fig. 1)

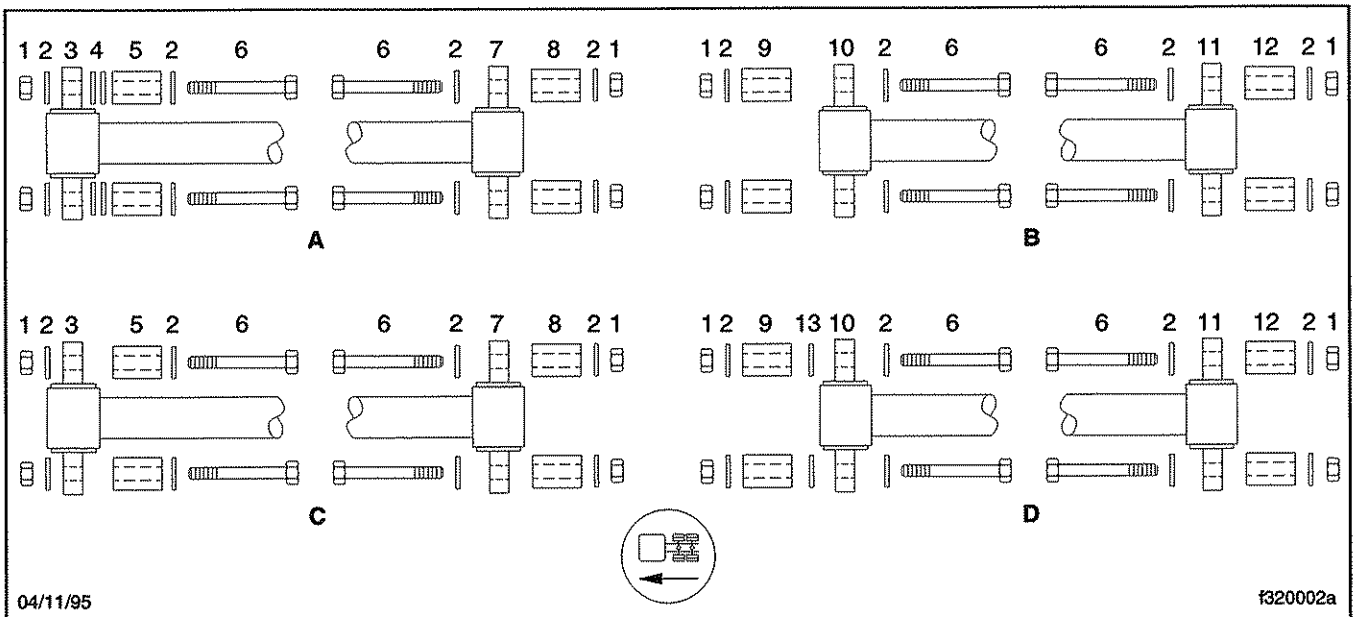
IMPORTANT: At all points where steel parts (including bolts, washers, and nuts) contact aluminum brackets, apply Alumilastic compound, or an equivalent, on the mating surfaces.

⚠ CAUTION

CAUTION: Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel parts contact each other, could lead to corrosion of the metals, resulting in damage to the suspension.

If installing forward and rear radius rods, install the forward radius rod before installing the rear radius rod.

1. If installing a forward radius rod, place the radius rod front pin on the front side of the forward spring bracket, and place the radius rod rear pin in front of the axle seat.



A. Forward Right-Side Radius Rod
B. Rear Right-Side Radius Rod
C. Forward Left-Side Radius Rod
D. Rear Left-Side Radius Rod

1. Hex Locknut
2. Hardened Washer
3. Forward Radius Rod Front Pin
4. Alignment Washers (install only on one side of front axle; right-side installation shown)
5. Forward Spring Bracket
6. Hexhead Bolt
7. Forward Radius Rod Rear Pin
8. Forward Axle Seat
9. Equalizer Bracket
10. Rear Radius Rod Front Pin
11. Rear Radius Rod Rear Pin
12. Rear Axle Seat
13. Alignment Washer (install only on one side of rear axle; left-side installation shown)

Fig. 1, Radius Rod Attachment (top view)

Radius Rod Removal and Installation

If installing a rear radius rod, place the radius rod pins between the rear side of the equalizer bracket and the front side of the axle seat.

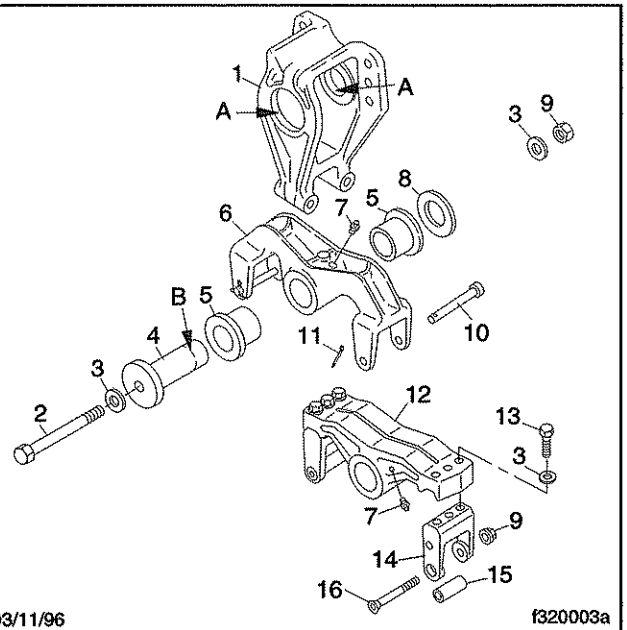
2. Install a hexhead bolt with a hardened washer through each end of the radius rod rear pin and the axle seat ears. Install the hardened washers and locknuts.
3. If installing a forward radius rod, install any previously removed axle alignment washers between the radius rod front pin and the forward spring bracket. Install the hexhead bolts, hardened washers, and locknuts.

   If installing a rear radius rod, install any previously removed axle alignment washers between the radius rod front pin and the equalizer bracket. Install the hexhead bolts, hardened washers, and locknuts.
4. Tighten the radius rod locknuts to the torque value in **Specifications, 400.**
5. After all of the radius rods are installed, check the rear axle alignment. For instructions, refer to **Group 35.** If necessary, adjust the axle alignment, using the instructions in **Subject 140.**

Equalizer Removal, Inspection, and Installation

Removal (See Fig. 1)

1. Chock the front tires.
2. Raise the rear of the vehicle, and block the axles with safety stands. Raise the vehicle frame so that all weight is removed from the leaf springs, then block the frame with safety stands. Make sure the stands will securely support the weight of the axles and frame. To allow access to the equalizer, remove the wheel assemblies on that side, using the instructions found in **Group 40**.
3. If removing an equalizer from a vehicle with two drive axles, remove the cotter pin from the outboard end of each spring retainer pin, then remove the retainer pins.



A. Apply Loctite here.
B. No grease here.
1. Equalizer Bracket
2. Hexbolt
3. Bearing Washer
4. Cap and Tube Assembly
5. Equalizer Assembly Bushing
6. Equalizer, One-Piece (tandem drive axles)
7. Grease Fitting
8. Wear Washer(s)
9. Locknut
10. Spring Retainer Pin
11. Cotter Pin
12. Equalizer, Three-Piece (tag or pusher axle)
13. Capscrew
14. Wear-Shoe Side-Restraint
15. Side-Restraint Sleeve
16. Flathead Bolt

Fig. 1, Equalizer Assembly

If removing an equalizer from a vehicle with a pusher or tag axle, remove the nuts from the flathead bolts in the wear-shoe side-restraints, on each end of the equalizer. Remove the flathead bolts and side-restraint sleeves. Remove the six capscrews and washers, and remove both wear-shoe side-restraints from the equalizer.

4. Remove the cap and tube assembly locknut, inboard bearing washer, bolt, and outboard bearing washer.
5. Insert a bar between the bottom of the equalizer and the equalizer bracket. Gently lever the weight of the equalizer off the cap and tube assembly. Insert a piece of barstock through the inboard cap and tube assembly bolt hole, and lightly tap the cap and tube assembly out of the equalizer.
6. Remove the equalizer from the equalizer bracket. Remove the wear washer(s) and equalizer bushings from the equalizer.

Inspection

1. Thoroughly clean the equalizer with steam or a hot soap solution. Inspect it for wear, cracks, or other damage. Replace the equalizer if any of these conditions are present.

⚠ WARNING

WARNING: Replace a worn or damaged equalizer. A broken equalizer could cause a loss of vehicle control, resulting in personal injury or property damage.

2. Inspect the equalizer bushings, cap and tube assembly, and the equalizer bracket. If wear, cracks, or other damage are present, replace the bushings, cap and tube assembly, or bracket.

Installation (See Fig. 1)

1. Apply a thin film of multipurpose chassis grease to the outside of the equalizer bushings, then install the bushings in the equalizer.

Equalizer Removal, Inspection, and Installation

NOTE: The equalizer is *not* symmetrical. To ensure that the equalizer is installed in the proper direction, an arrow is cast into its top surface.

2. Install the equalizer in the equalizer bracket. Make sure that the arrow cast into the top of the equalizer is pointing toward the frame rail. **See Fig. 2.**

NOTE: The next four steps must be completed before the Loctite begins to cure (approximately 5 to 10 minutes).

IMPORTANT: Be careful to prevent grease from contacting the inboard surface of the cap and tube assembly, where the Loctite is applied.

3. Apply Loctite 680 to both interior surfaces of the equalizer bracket, where the cap and tube assembly is inserted. Apply multipurpose chassis grease to the cap and tube assembly, except the last inch which connects to the equalizer bracket. **See Fig. 1,** Ref. B. Start the cap and tube assembly into the equalizer, through the equalizer bracket.

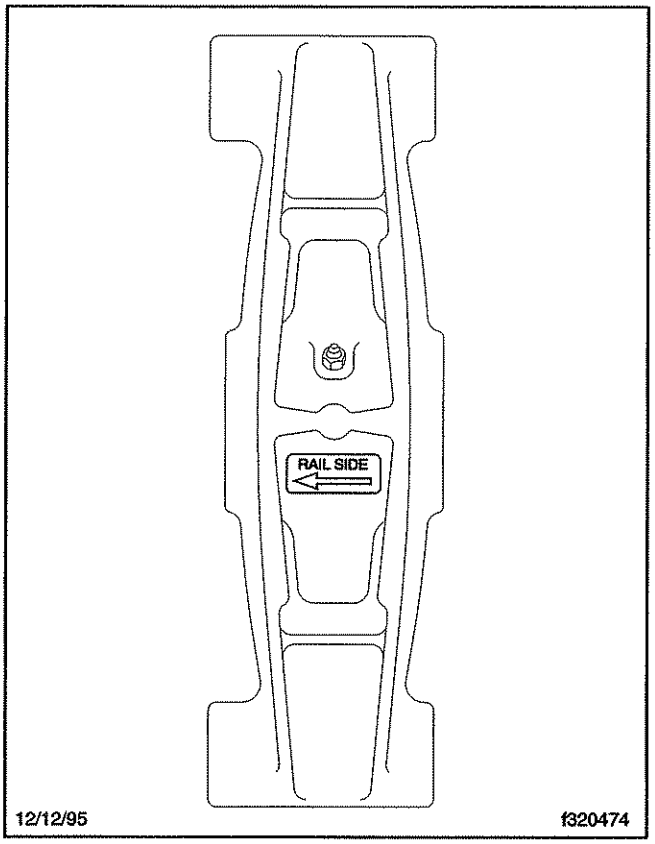


Fig. 2, Equalizer Marking

4. Push the cap and tube assembly part way through the equalizer, then place the wear washer(s) between the inboard equalizer bushing and the equalizer bracket. Push the cap and tube assembly the rest of the way into the equalizer bracket.
5. Place the outboard bearing washer on the equalizer cap and tube assembly bolt, and install the bolt in the cap and tube assembly.
6. Install the inboard bearing washer and locknut on the cap and tube assembly bolt. Tighten the locknut to the torque value in **Specifications, 400.**
7. Lubricate the equalizer assembly by applying multipurpose chassis grease at the grease fitting. Lubricate with a hand gun or pressure gun until grease is forced past the bushing seals, or if equipped with a pressure-relief grease fitting, until grease is forced out from the base of the pressure relief fitting.
8. If installing an equalizer on a vehicle with two drive axles, apply Alumilastic compound, or an equivalent, to the spring retainer pins; then install them from the inboard side. Be sure the hooked ends of the spring leaves are above the retainer pins. Install a cotter pin in the outboard end of each retainer pin, and lock it in place.

   If installing an equalizer on a vehicle with a pusher or tag axle, apply Alumilastic compound, or an equivalent, to the surfaces where the wear-shoe side-restraints contact the equalizer. Attach the side-restraints to the equalizer, offsetting them toward the inboard side of the equalizer. Tighten the equalizer wear-shoe capscrews to the torque value in **Specifications, 400.** Install the side-restraint sleeves and flathead bolts in the wear-shoe side-restraints. Be sure the hooked ends of the spring leaves are above the side-restraint sleeves. Install the nuts, and tighten them to the applicable torque value in **Specifications, 400.**

⚠ CAUTION

CAUTION: Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel contact each other, could lead to corrosion of the metals, resulting in suspension damage.

9. Install the wheel assemblies, using the instructions found in **Group 40.** Remove the safety stands from under the frame and axle, and lower the vehicle.
10. If the radius rods have been loosened, or the equalizer bracket has been removed, check the rear axle alignment. For instructions, refer to **Group 35.** If necessary, adjust the axle alignment using the instructions in **Subject 140.**

Replacement (See Fig. 1)

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

1. Chock the front tires.
2. Raise the frame so that all weight is removed from the leaf springs; then block the frame with safety stands. Raise the rear axle until the spring no longer contacts the spring bracket wear shoes and the spring retainer pin (or side-restraint sleeve); then block the axle. Make sure the stands will securely support the weight of the axles and frame. To access the spring assembly, remove the wheel assembly. See **Group 40** for instructions.
3. If equipped with two drive axles, remove the cotter pin from the spring retainer pin on the end of the equalizer where the spring is being replaced. Drive the spring retainer pin out of the equalizer.

   If equipped with a pusher or tag axle, remove the nut from the flathead bolt on the end of the equalizer where the spring is being replaced. Remove the bolt and the side-restraint sleeve from the wear-shoe side-restraint.
4. Remove the U-bolt high nuts, hardened washers, U-bolt retainer, U-bolts, and upper U-bolt pad.
5. Remove the spring assembly by lifting it off the axle seat, then moving it toward the equalizer, out of the forward or rear spring bracket.
6. Using chassis grease, lubricate the new spring assembly where the ends will contact the stationary wear shoes in the spring bracket and equalizer.
7. Place the new spring assembly in the spring bracket and on the axle seat. Make sure the spring center-bolt head seats in the axle seat hole.
8. If the upper U-bolt pad is aluminum, apply Alumilastic compound, or an equivalent, to those areas of the pad that will come in contact with the U-bolts and with the upper spring leaf.

⚠ CAUTION

Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel contact each other, could lead to corrosion of the metals, resulting in suspension damage.

9. Place the upper U-bolt pad on the spring assembly. Place the U-bolts over the upper U-bolt pad and the spring assembly.
10. Install the U-bolt retainer, hardened washers, and U-bolt high nuts. Tighten the high nuts until snug.
11. If installing a spring assembly on a vehicle with two drive axles, apply Alumilastic compound, or an equivalent, to the spring retainer pins, then install them from the inboard side. Be sure the hooked ends of the spring leaves are above the retainer pins. Install a cotter pin in the outboard end of each retainer pin, and lock it in place.

    If installing a spring assembly on a vehicle with a pusher or tag axle, install the side-restraint sleeves and flathead bolts in the wear-shoe side-restraints. Be sure the hooked ends of the spring leaves are above the side-restraint sleeves. Install the nuts, and tighten them to the applicable torque value in **Specifications 400**.
12. Tighten the axle U-bolt high nuts as described in **Specifications 400**.

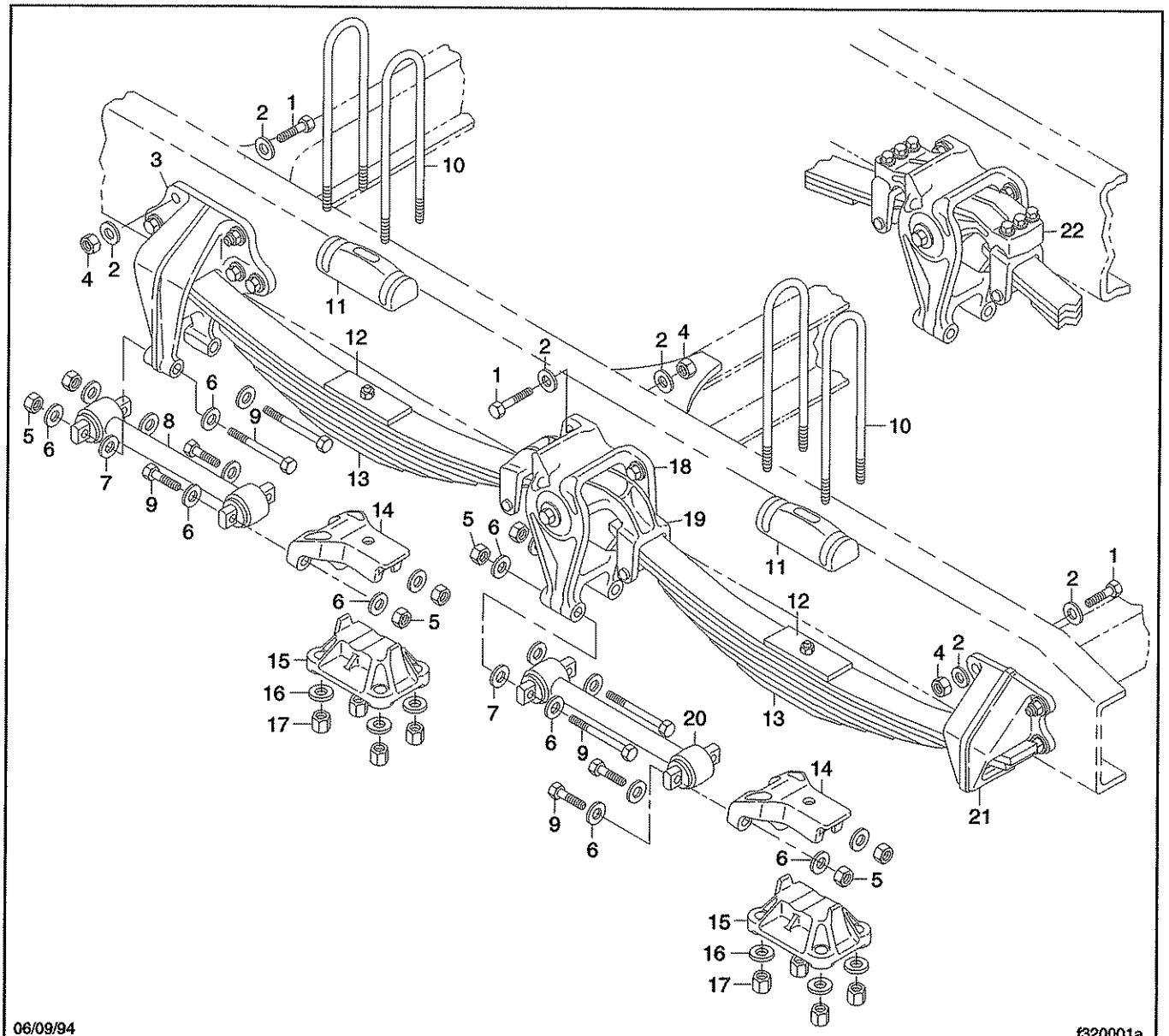
⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets,and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, refer to **Group 32** of the *Business Class Trucks Maintenance Manual.*

13. Install the wheel assembly, using the instructions found in **Group 40**. Remove the safety stands from under the frame and axle, and lower the vehicle.

Spring Assembly Replacement



1. Suspension Bracket Hexbolt
2. Hardened Washer
3. Forward Spring Bracket
4. Suspension Bracket Hex Locknut
5. Torque Arm Hex Locknut
6. Hardened Washer
7. Axle Alignment Washer
8. Forward Torque Arm
9. Torque Arm Hexbolt
10. U-Bolt
11. U-Bolt Pad
12. Spring Liner
13. Leaf Spring Assembly
14. Spring Seat
15. U-Bolt Retainer
16. Hardened Washer
17. U-Bolt High Nut
18. Equalizer Bracket
19. Equalizer, One-Piece (tandem drive axles)
20. Rear Torque Arm
21. Rear Spring Bracket
22. Equalizer, Three-Piece (tag or pusher axle)

Fig. 1, Tandem-Axle Spring Suspension

14. Check the rear axle alignment. For instructions, see **Group 35.** If necessary, adjust the axle alignment, using the instructions in **Subject 140.**

Spring Bracket and Equalizer Bracket Replacement

Replacement (See Fig.1)

⚠ WARNING

Failure to replace worn, cracked, or damaged spring brackets or equalizer brackets could result in breakage of the bracket, which could cause a loss of vehicle control, resulting in personal injury or property damage.

IMPORTANT: At all points where steel parts (including bolts, washers, and nuts) contact the aluminum spring brackets, apply Alumilastic compound, or an equivalent, on the mating surfaces.

⚠ CAUTION

Failure to apply Alumilastic compound, or an equivalent, to areas where aluminum and steel parts contact each other, could lead to corrosion of the metals, resulting in damage to the suspension.

1. Chock the front tires.
2. Raise the rear of the vehicle, and block the axles with safety stands. Raise the vehicle frame so that all weight is removed from the leaf springs, then block the frame with safety stands. Make sure the stands will securely support the weight of the axles and frame.
3. If removing the forward spring bracket or the equalizer bracket, note the number of any axle alignment washers, then remove the fasteners that attach the radius rod to the forward spring bracket or equalizer bracket. Remove any axle alignment washers.
4. If removing an equalizer bracket, remove the equalizer. For instructions, refer to **Subject 110.**
5. Remove the fasteners that attach the forward or rear spring bracket, or equalizer bracket, to the frame rail. Remove the bracket.
6. Place the new spring bracket or equalizer bracket on the frame rail. Align the mounting holes, and install the bracket bolts, hardened washers, and locknuts.

NOTE: If installing the forward spring bracket, install the nuts for the top two bolts on the outboard side of the frame rail, and install the nuts for the bottom four bolts on the inboard side of the frame rail. See **Fig. 2.**

If installing the equalizer bracket, for clearance, install all of the nuts on the inboard side of the frame rail. See **Fig. 2.**

If installing the rear spring bracket, install the nuts for the top two bolts on the outboard side of the frame rail, and install the nuts for the bottom two bolts on the inboard side of the frame rail. See **Fig. 2.**

7. Tighten the bracket mounting locknuts to the applicable torque value in **Specifications, 400.**

⚠ CAUTION

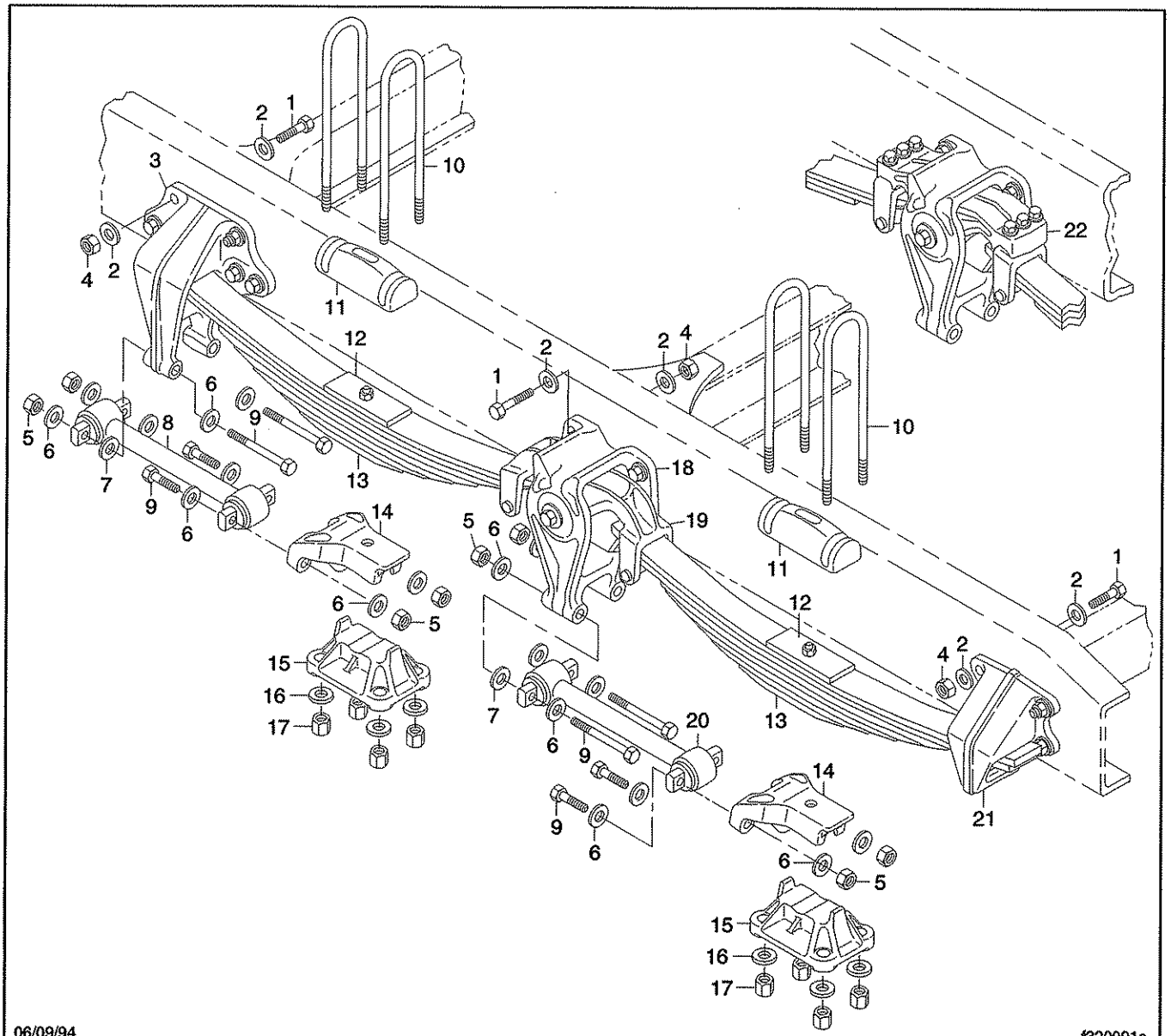
Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** of the *Business Class Trucks Maintenance Manual.*

8. When replacing the forward spring bracket or equalizer bracket, install any previously removed axle alignment washers between the forward radius rod front pin and the forward spring bracket, or between the rear radius rod front pin and the equalizer bracket, as applicable. See **Fig. 3.**

   Install bolts with hardened washers in the radius rod front pin, and the forward spring bracket or equalizer bracket. Install the hardened washers and locknuts, and tighten the locknuts to the torque value in **Specifications, 400.**
9. If replacing an equalizer bracket, install the equalizer. For instructions, see **Subject 110.**
10. Remove the safety stands from under the frame and axle, and lower the vehicle.
11. Check the rear axle alignment. For instructions, see **Group 35.** If necessary, adjust the axle alignment, using the instructions in **Subject 140.**

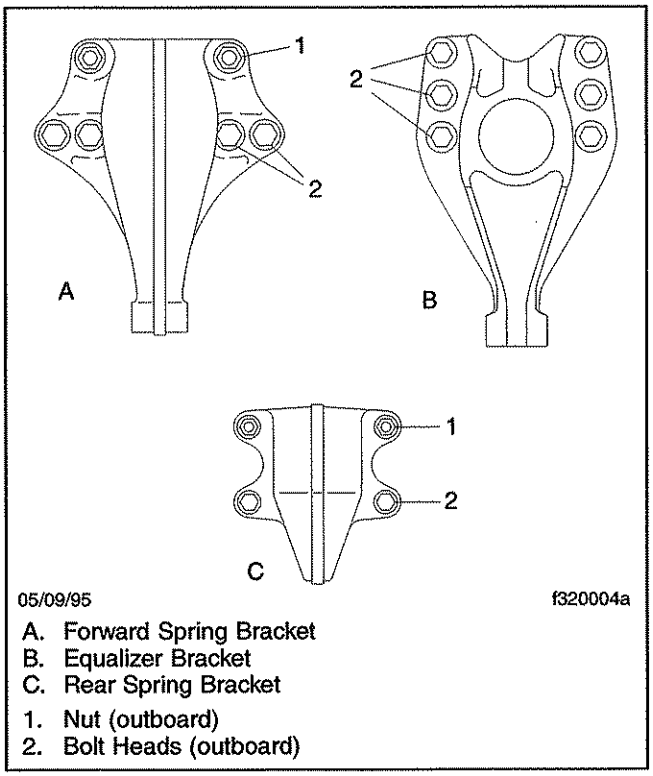
Spring Bracket and Equalizer Bracket Replacement



1. Suspension Bracket Hexbolt
2. Hardened Washer
3. Forward Spring Bracket
4. Suspension Bracket Hex Locknut
5. Radius Rod Hex Locknut
6. Hardened Washer
7. Axle Alignment Washer
8. Forward Radius Rod
9. Radius Rod Hexbolt
10. U-Bolt
11. U-Bolt Pad
12. Spring Liner
13. Leaf Spring Assembly
14. Spring Seat
15. U-Bolt Retainer
16. Hardened Washer
17. U-Bolt High Nut
18. Equalizer Bracket
19. Equalizer, One-Piece (tandem drive axles)
20. Rear Radius Rod
21. Rear Spring Bracket
22. Equalizer, Three-Piece (tag or pusher axle)

Fig. 1, Tandem-Axle Spring Suspension

Spring Bracket and Equalizer Bracket Replacement

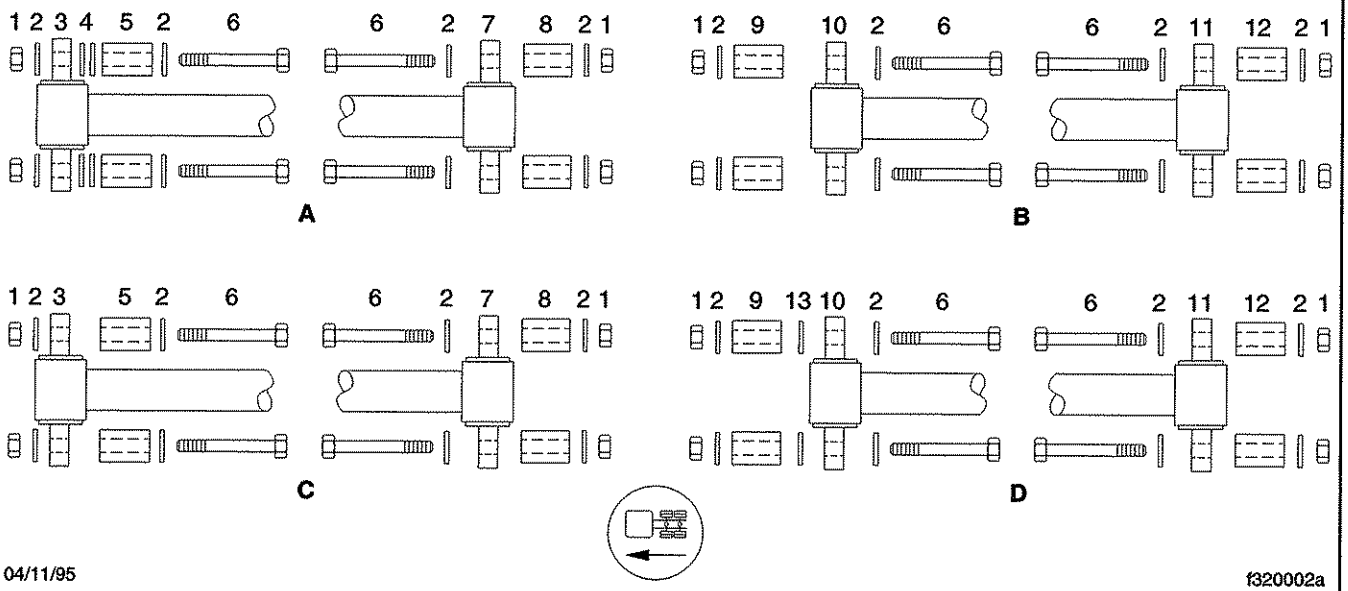


A. Forward Spring Bracket
B. Equalizer Bracket
C. Rear Spring Bracket

1. Nut (outboard)
2. Bolt Heads (outboard)

Fig. 2, Frame Brackets

Spring Bracket and Equalizer Bracket Replacement



A. Forward Right-Side Radius Rod
B. Rear Right-Side Radius Rod
C. Forward Left-Side Radius Rod
D. Rear Left-Side Radius Rod

1. Hex Locknut
2. Hardened Washer
3. Forward Radius Rod Front Pin
4. Alignment Washers (install only on one side of front axle; right-side installation shown)
5. Forward Spring Bracket
6. Hexhead Bolt
7. Forward Radius Rod Rear Pin
8. Forward Axle Seat
9. Equalizer Bracket
10. Rear Radius Rod Front Pin
11. Rear Radius Rod Rear Pin
12. Rear Axle Seat
13. Alignment Washer (install only on one side of rear axle; left-side installation shown)

Fig. 3, Radius Rod Attachment (top view)

Adjustment

1. Using a straightedge and a tape measure, determine the amount of adjustment needed to align the forward-rear axle at a right angle to the frame. For instructions, see **Group 35**. The difference in measurements between the sides of the vehicle is the approximate amount that the trailing end of the forward-rear axle will have to be brought forward, or the leading end will have to be moved back to align it at a right angle to the frame. See **Fig. 1**.

   If the forward-rear axle alignment is within specifications, go to the step that begins "Using a center-point bar, determine...".

2. Chock the front tires. On both sides of the forward-rear axle, loosen the axle U-bolts enough to allow the springs to shift on the axle seats.

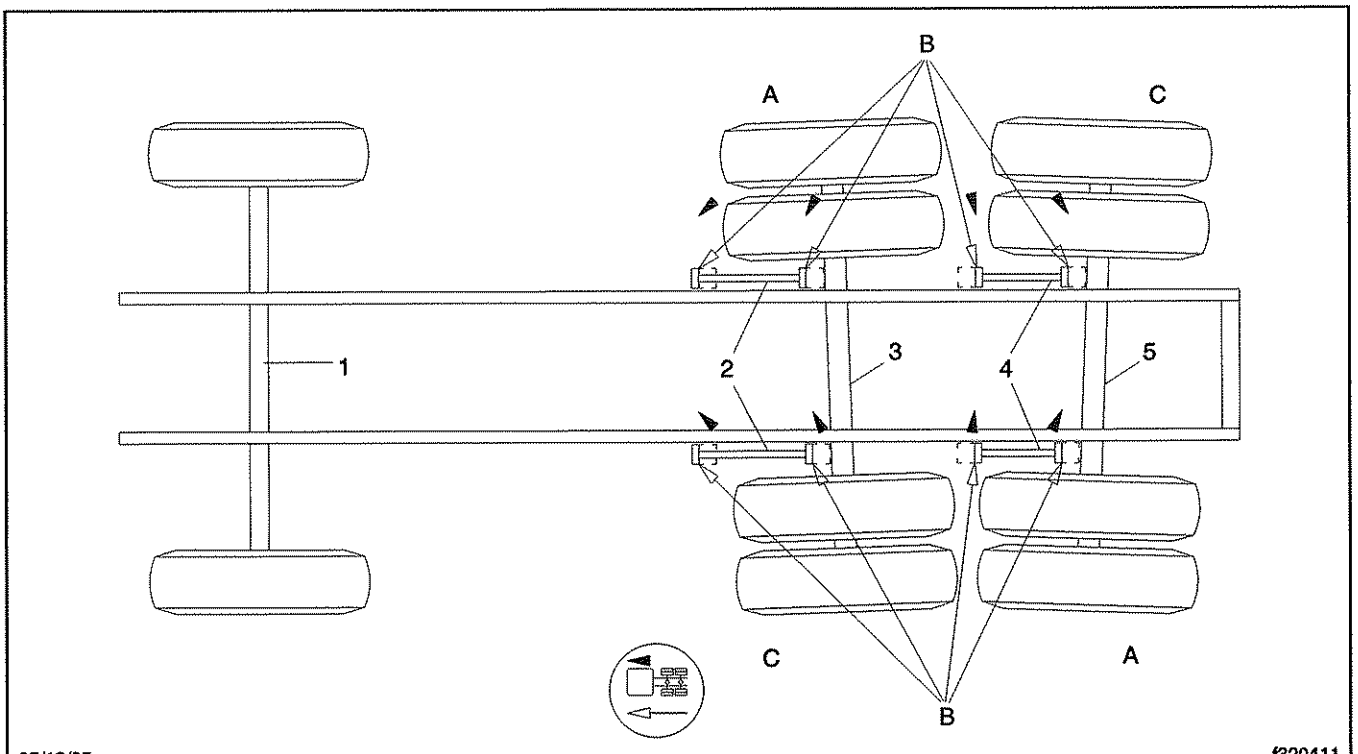
3. On the side of the vehicle that is to be adjusted, remove the fasteners that attach the forward radius rod to the forward spring bracket. Remove any axle alignment washers.

NOTE: To move the leading end of the forward-rear axle rearward, *remove* alignment washers from between the radius rod and the leading end of the forward spring bracket or *add* alignment washers between the radius rod and the forward-rear axle seat.

To move the trailing end of the forward-rear axle forward, *remove* alignment washers from between the radius rod and the forward-rear axle seat on the trailing end.

Whenever possible, alignment washers should be *removed* instead of added.

4. Raise the frame just enough to relieve the weight from the springs. Place safety stands under the



1. Front Axle
2. Forward-Rear Axle Radius Rod
3. Forward-Rear Axle
4. Rearmost Axle Radius Rod
5. Rearmost Axle

A. Leading End
B. Possible Adjustment Points
C. Trailing End

Fig. 1, Tandem Axle, Shown Out of Alignment

Rear Axle Alignment Adjustment

frame. Make sure the stands will securely support the weight of the frame.

5. Move the loosened end of the axle forward or backward as needed, by rolling the wheels.
6. Insert or remove axle alignment washers at the appropriate location (front or rear of the left-hand or right-hand radius rod) to bring the forward-rear axle into alignment. Install the hexhead bolt, hardened washers, and locknut in the radius rod pin and forward spring bracket or axle seat.
7. Place an equal thickness of washers on the other end of the radius rod pin, and install the fasteners.
8. Tighten the radius rod locknuts to the torque value in **Specifications 400.**
9. Remove the safety stands, and lower the vehicle.
10. Check the forward-rear axle alignment with the straightedge and the tape measure. If alignment is within specifications, center the spring in the forward spring bracket, if needed, then tighten the axle U-bolt nuts to the torque value in **Specifications 400.**

    If not in alignment, repeat all of the steps above.

⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** in the vehicle maintenance manual.

11. Using a center-point bar, determine the difference between the forward-rear and the rearmost axles' center-to-center measurements on each side of the vehicle. For instructions, see **Group 35.** This difference is the approximate distance that the leading end of the rearmost axle will have to be adjusted rearward, or that the trailing end will have to be adjusted forward, to align it at a right angle to the frame, and to align it parallel to the forward-rear axle. See **Fig. 1.**
12. On both sides of the rearmost axle, loosen the axle U-bolts enough to allow the springs to shift on the axle seats.
13. On the side of the vehicle that is to be adjusted, remove the fasteners that attach the rear radius rod to the equalizer bracket. Remove any axle alignment washers.
14. Raise the frame just enough to relieve the weight from the springs. Place safety stands under the frame. Make sure the stands will securely support the weight of the frame.
15. Move the loosened end of the axle forward or backward, by rolling the wheels. Move the axle just enough to provide space to allow installation of alignment washers between the equalizer bracket and the radius rod pin.
16. Between one end of the radius rod pin and the equalizer bracket, insert the additional thickness of alignment washers needed to make up for the difference in center-point bar measurements.

    For example, if one end of the axle was equipped with a 4.5 mm (3/16-inch) thickness of washers, and the difference in the center-point bar measurements is 6 mm (1/4 inch) less on that side, add an additional 6 mm (1/4 inch) of washers — for a total of 10.5 mm (7/16 inch) — to correct the alignment.

    Or, if one end of the axle was equipped with a 6 mm (1/4-inch) thickness of washers, and the difference in center-point bar measurements is 4.5 mm (3/16 inch) more on that side, install a 1.6 mm (1/16-inch) thickness of washers in place of the 6 mm (1/4-inch) thickness.
17. Install the bolt, hardened washers, and locknut in the equalizer bracket and the radius rod pin. Place an equal thickness of alignment washers on the other end of the radius rod pin, and install the fasteners at that end.
18. Tighten the radius rod locknuts to the torque value in **Specifications 400.**
19. Remove the safety stands, and lower the vehicle. Remove the chocks from the front tires.
20. Using the center-point bar, check the rearmost axle alignment. If alignment is within specifications, center the spring in the rear spring bracket, if needed, then tighten the axle U-bolt nuts to the applicable torque value in **Specifications 400.**

    If not in alignment, repeat the applicable steps above.

Rear Axle Alignment Adjustment

⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** in the vehicle maintenance manual.

Specifications

Torque Values			
Description	**Size**	**IFI Grade**	**Torque lbf·ft (N·m)**
Equalizer Bracket-to-Frame Rail Locknut*	3/4–10	C	240 (325)
Forward Spring Bracket-to-Frame Rail Locknut*	3/4–10	C	240 (325)
Rear Spring Bracket-to-Frame Rail Locknut*	5/8–11	C	135 (180)
Axle U-Bolt High Nuts	7/8–14	C	Stage 1: Hand tighten Stage 2: 60 (81)† Stage 3: 200 (271)† Stage 4: 420 to 500 (571 to 680)†
Radius Rod Locknut*	5/8–18	C	135 (184)
Equalizer Cap and Tube Assembly Locknut*	3/4–16	C	270 (365)
Equalizer Wear Shoe Capscrew	5/8–11	8	135 (184)
Side-Restraint Sleeve Locknut	1/2–13	C	68 (93)

* Cadmium-plated, wax-coated nuts, and grade 8 hexbolts with phosphate- and oil-coated threads; both used with hardened washers.
† Tighten in a diagonal pattern as shown in **Fig. 1.**

Table 1, Torque Values

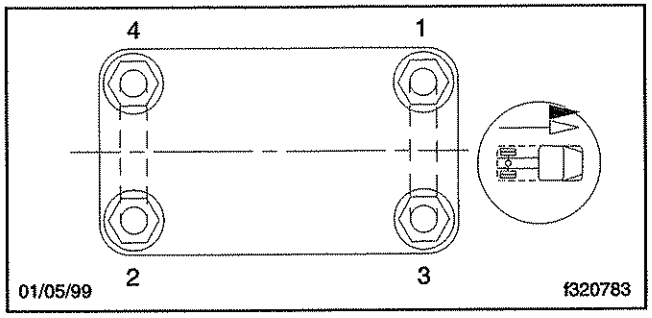


Fig. 1, Tightening Pattern for U-bolt High Nuts

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General Description

The Chalmers 800 Series Rear Suspension is a walking beam-type tandem axle suspension that uses hollow rubber springs instead of leaf springs or air bags. Each hollow rubber spring is mounted between a frame-rail plate and the center (front-to-rear) of the steel walking beam. A sawhorse bracket assembly is attached to the frame and provides mounting points for the lower torque rods that tie the axles to the frame. The upper torque rods are fastened to brackets that bolt to the frame side rails and to tower assemblies that are welded to the top of the differential housings. **See Fig. 1.**

The 800 Series Rear Suspension allows a high degree of both parallel and diagonal articulation, while maintaining wheel load equalization to within 3%.

The Chalmers suspension design separates the rear suspension's responsibility for supporting/cushioning the load from that of locating/guiding the axles. The suspension is very light, relative to its load carrying capacity, but requires very little maintenance. In fact, there are no lubrication fittings since grease and oil are never needed.

The 800 Series Rear Suspension is available in two different maximum load capacities: 18,000 kg (40,000 lb) and 21,000 kg (46,000 lb). The 18,000 kg version is easily distinguished from the 21,000 kg version since the upper torque rods do not cross over one another on the 18,000 kg version.

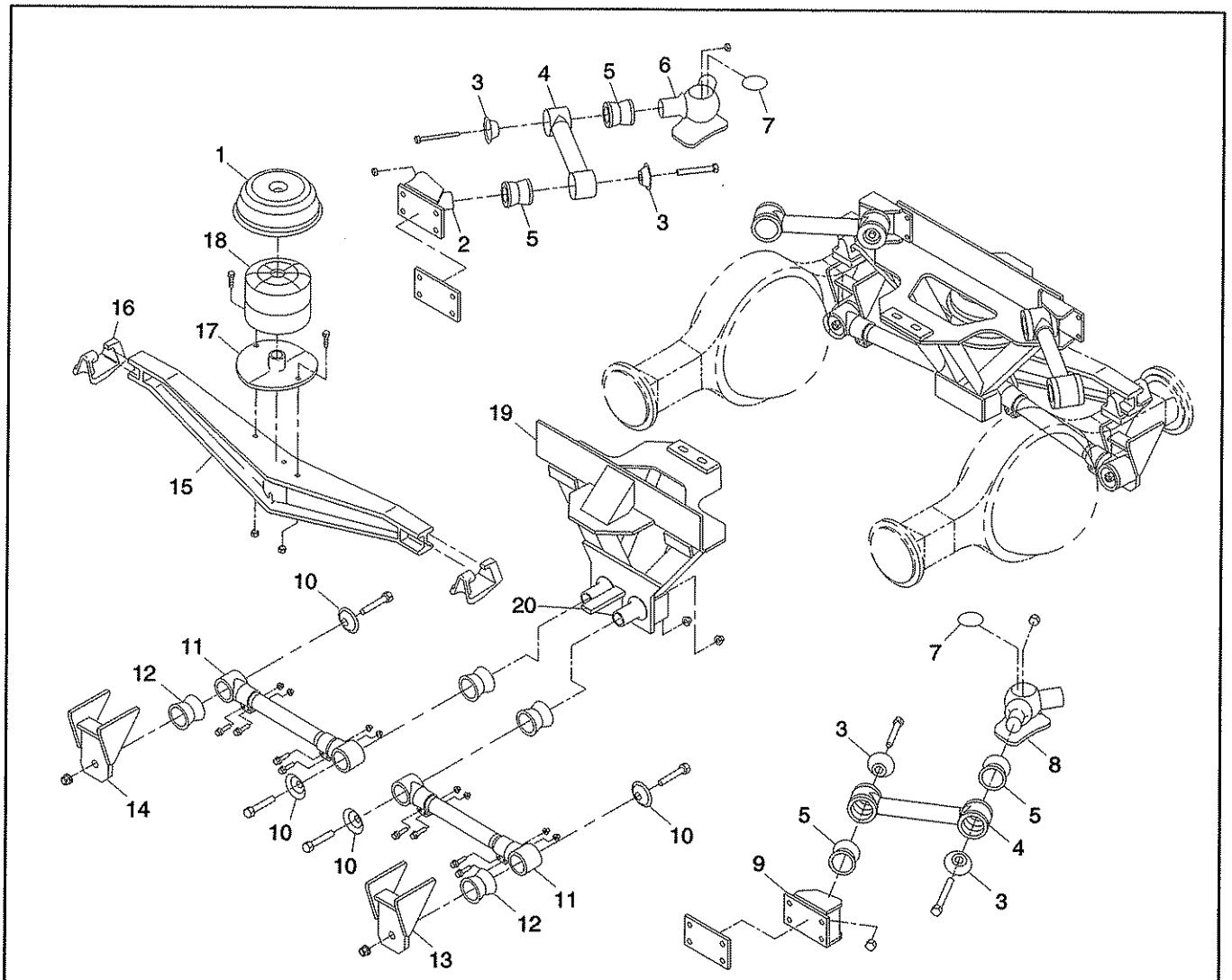
The 800 Series is also available in three different axle spacings: 54-inch, 60-inch, and 72-inch axle-to-axle. The axle-to-axle spacing dimension is often included as part of the suspension name, e.g. "Chalmers 854 Rear Suspension" or "Chalmers 860 Suspension."

Shock absorbers are optional on all versions of the suspension, and available in two styles—beam mounted and axle housing mounted.

Other variations depend on whether the suspension is installed on a truck (high-mount) or a tractor (low-mount) and whether high center-of-gravity or low center-of-gravity is desired.

The rear suspension may be precision-aligned by adjusting the length of the lower torque rods. These rods have both left and right hand threads cut on the same tube so rotating the tube changes the effective length of the tube.

General Description



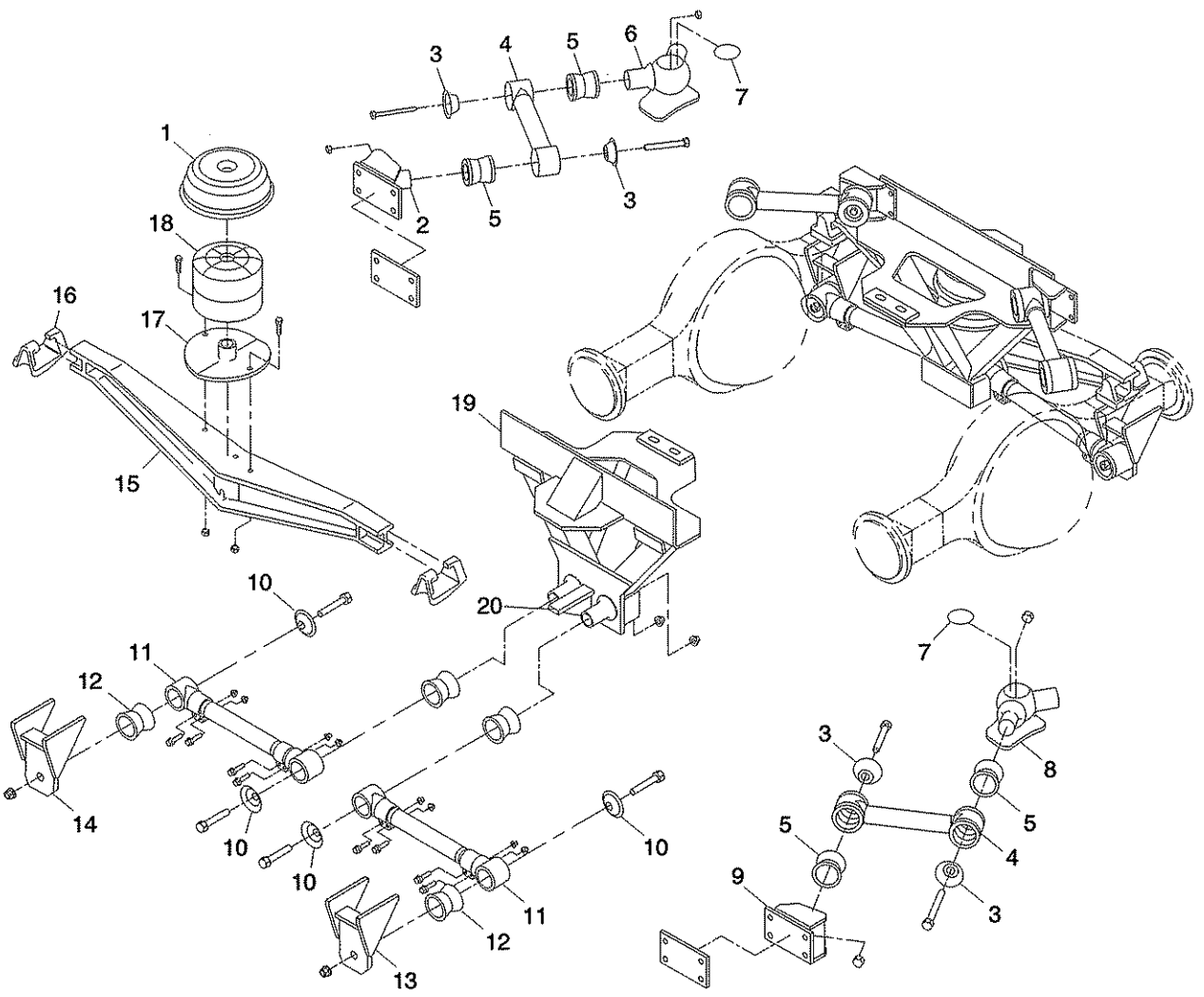
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1. Restrictor Can
2. Upper Torque Rod Frame Bracket (LH forward)
3. Spigot Cap (upper)
4. Upper Torque Rod
5. Torque Rod Bushing (upper)
6. Forward Rear Axle Tower
7. Rear Axle Tower Plug
8. Rearmost Rear Axle Tower
9. Upper Torque Rod Frame Bracket (LH rear)
10. Spigot Cap (lower)
11. Lower Torque Rod (adjustable)
12. Torque Rod Bushing (lower)
13. Lower Torque Rod Axle Housing Bracket (LH rear)
14. Lower Torque Rod Axle Housing Bracket (LH forward)
15. Beam
16. Axle Housing Beam Saddle Bracket
17. Beam Spring Plate
18. Hollow Rubber Spring
19. Sawhorse Bracket Assembly
20. Beam Stop

Fig. 1, Chalmers 800 Series Tandem Axle Suspension (40k capacity shown without shock absorbers)

Restrictor Can Removal, Inspection, and Installation

Removal (See Fig. 1)



01/11/96 f320444

1. Restrictor Can
2. Upper Torque Rod Frame Bracket (LH forward)
3. Spigot Cap (upper)
4. Upper Torque Rod
5. Torque Rod Bushing (upper)
6. Forward Rear Axle Tower
7. Rear Axle Tower Plug
8. Rearmost Rear Axle Tower
9. Upper Torque Rod Frame Bracket (LH rear)
10. Spigot Cap (lower)
11. Lower Torque Rod (adjustable)
12. Torque Rod Bushing (lower)
13. Lower Torque Rod Axle Housing Bracket (LH rear)
14. Lower Torque Rod Axle Housing Bracket (LH forward)
15. Beam
16. Axle Housing Beam Saddle Bracket
17. Beam Spring Plate
18. Hollow Rubber Spring
19. Sawhorse Bracket Assembly
20. Beam Stop

Fig. 1, Chalmers 800 Series Tandem Axle Suspension (40k capacity shown without shock absorbers)

Restrictor Can Removal, Inspection, and Installation

1. If necessary, power wash the spring restrictor can area to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Raise the rear of the vehicle just enough to remove all weight from the rear axles, and place safety stands under the frame to support the vehicle in its raised position.
4. Remove the two bolts and nuts that secure the walking beam spring plate (**see Fig. 1**, Ref. 17) to the walking beam assembly. Discard the fasteners.

NOTE: On 54-inch spread suspensions, it may be necessary to remove either the front or rear tires to allow spring assembly removal.

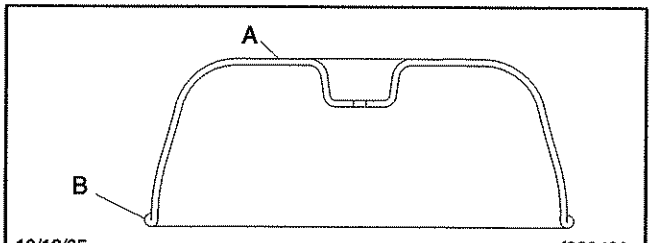
5. Pull the lower spring plate, rubber spring, and restrictor can as one assembly outward, off the beam assembly. **See Fig. 1**, Refs. 1, 17, 18.
6. Separate the restrictor can, spring, and spring plate.

Inspection

1. Carefully inspect the restrictor can for cracks or severe corrosion. Pay special attention to the top surface of the can and the can rim. **See Fig. 2.**

NOTE: It is recommended that both restrictor cans be replaced at the same time to insure evenness of ride and handling characteristics.

2. Replace a cracked or severely corroded restrictor can.



A. Inspect top surface for cracks or severe corrosion.
B. Carefully inspect can rim for cracks.

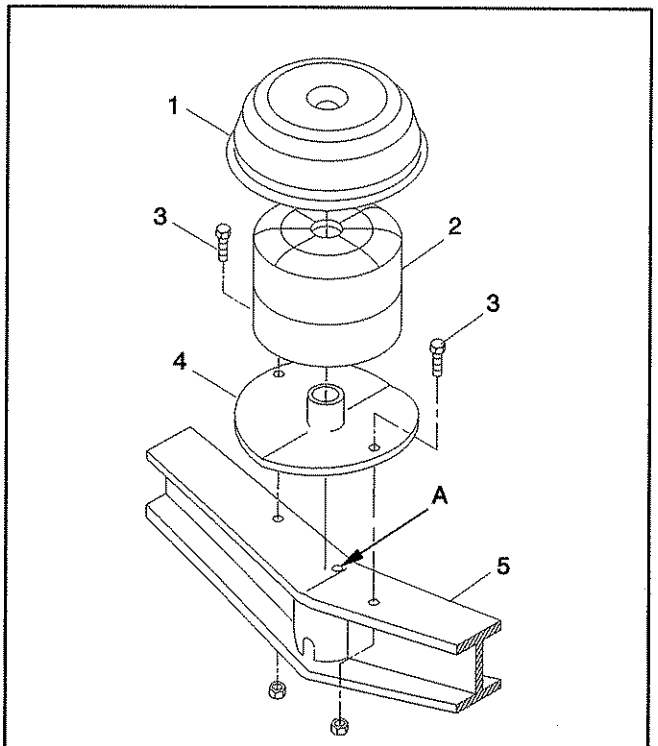
Fig. 2, Restrictor Can Inspection Areas

Installation

1. Using a stiff wire brush or gasket scraper, clean rust and road dirt from the spring plate. Also, make sure that the center vent holes in the plate and in the walking beam are free of rust and debris. **See Fig. 3.**
2. Inspect the spring plate for cracks; replace it if any are present.

IMPORTANT: Never use any mineral based oils, greases, jellies, or solvent soaps to aid in the assembly of rubber suspension parts. Use only lubricants specifically designed for use with rubber compounds.

3. Position the rubber spring on the spring plate so it is upside down, relative to its original orientation. Make sure that the spring vent hole is centered on



A. Make sure that the vent hole in the walking beam is free of rust and debris.

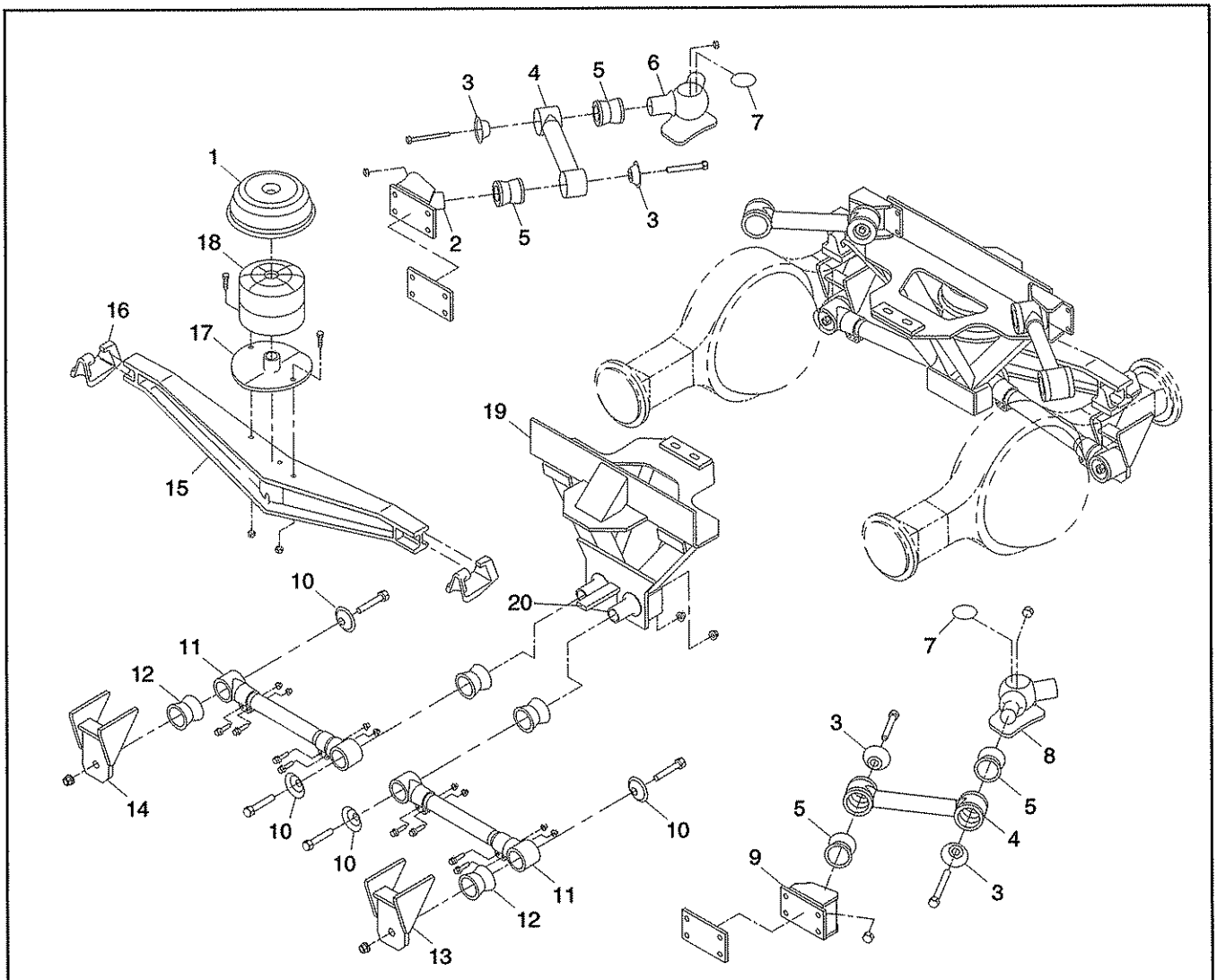
1. Spring Restrictor Can
2. Hollow Rubber Spring
3. Spring Plate Bolt
4. Spring Plate
5. Walking Beam

Fig. 3, Spring Assembly Components

the spring plate tube. Place the new restrictor can over the spring; make sure the can is centered on the spring.

4. Slide, as one assembly, the spring plate, spring, and restrictor cap, into position on the walking beam.
5. Install and tighten the spring plate fasteners 47 N·m (35 lbf·ft).
6. Check the gap between the spring and the restrictor can to make sure it is even, all the way around the can. Rotate the spring and/or can as necessary to make the gap even.
7. Remove the safety stands from under the vehicle, then lower the vehicle.
8. Remove the chocks from the tires.

Replacement (See Fig. 1)



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1. Restrictor Can
2. Upper Torque Rod Frame Bracket (LH forward)
3. Spigot Cap (upper)
4. Upper Torque Rod
5. Torque Rod Bushing (upper)
6. Forward Rear Axle Tower
7. Rear Axle Tower Plug
8. Rearmost Rear Axle Tower
9. Upper Torque Rod Frame Bracket (LH rear)
10. Spigot Cap (lower)
11. Lower Torque Rod (adjustable)
12. Torque Rod Bushing (lower)
13. Lower Torque Rod Axle Housing Bracket (LH rear)
14. Lower Torque Rod Axle Housing Bracket (LH forward)
15. Beam
16. Axle Housing Beam Saddle Bracket
17. Beam Spring Plate
18. Hollow Rubber Spring
19. Sawhorse Bracket Assembly
20. Beam Stop

Fig. 1, Chalmers 800 Series Tandem Axle Suspension (40k capacity shown without shock absorbers)

Rubber Spring Replacement

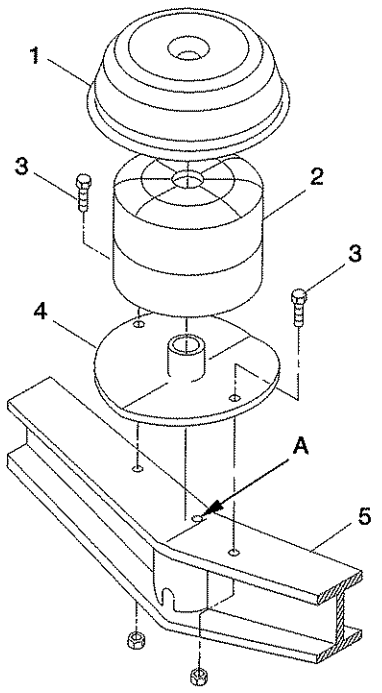
1. If necessary, power wash the spring restrictor can area to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Raise the rear of the vehicle just enough to remove all weight from the rear axles, and place safety stands under the frame to support the vehicle in its raised position.
4. Remove the two bolts and nuts that secure the walking beam spring plate (**see Fig. 1**, Ref. 17) to the walking beam assembly. Discard the fasteners.

NOTE: On 54-inch spread suspensions, it may be necessary to remove either the front or rear tires to allow spring assembly removal.

5. Pull the lower spring plate, rubber spring, and restrictor can as one assembly outward, off the beam assembly. **See Fig. 1**, Refs. 1, 17, 18.
6. Separate the restrictor can, spring, and spring plate; discard the spring.
7. Using a stiff wire brush or gasket scraper, clean rust and road dirt from the spring plate. Also, make sure that the center vent holes in the plate and in the walking beam are free of rust and debris. **See Fig. 2.**
8. Inspect the spring plate for cracks; replace it if any are present.

IMPORTANT: Never use any mineral based oils, greases, jellies, or solvent soaps to aid in the assembly of rubber suspension parts. Use only lubricants specifically designed for use with rubber compounds.

9. Position the new rubber spring on the spring plate, making sure that the vent hole is centered on the spring plate tube. Place the restrictor can over the spring; make sure the can is centered on the spring.
10. Slide, as one assembly, the spring plate, spring, and restrictor cap, into position on the walking beam.
11. Install and tighten the spring plate fasteners 47 N·m (35 lbf·ft).
12. Remove the safety stands from under the vehicle, then lower the vehicle.
13. Remove the chocks from the tires.



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A. Make sure that the vent hole in the walking beam is free of rust and debris.

1. Spring Restrictor Can
2. Hollow Rubber Spring
3. Spring Plate Bolt
4. Spring Plate
5. Walking Beam

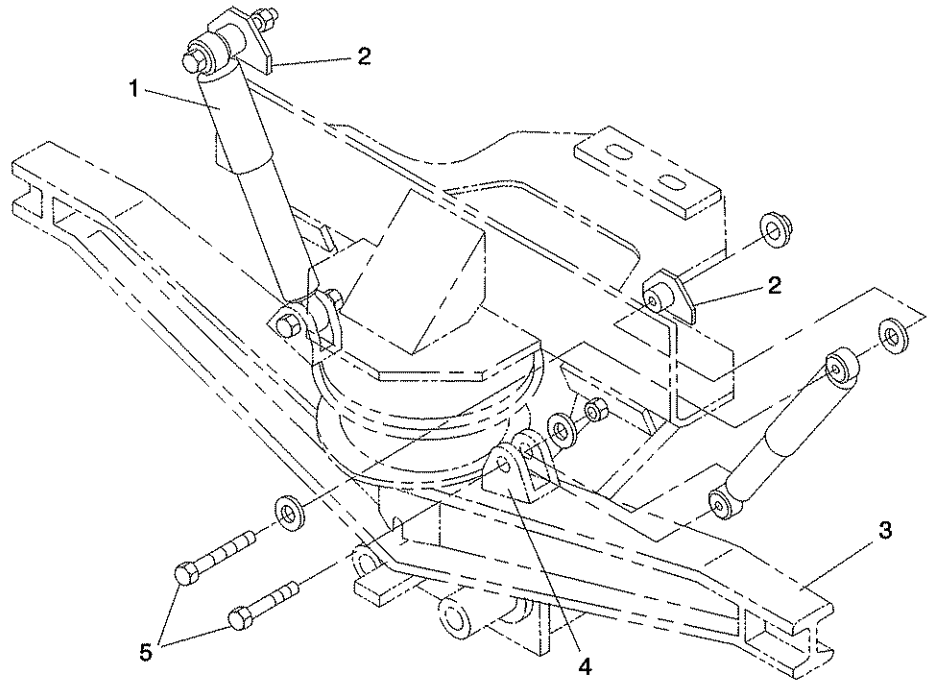
Fig. 2, Spring Assembly Components

Replacement

The Chalmers 800 Series Suspension may be fitted with either beam-mounted or axle-mounted shock absorbers. **See Fig. 1** and **Fig. 2.** The replacement procedure is essentially the same for both types of shock absorber.

1. If necessary, power wash the rear suspension to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Remove the shock absorber mounting fasteners.
   - 3.1 On beam-mounted shocks, remove the upper and lower bolts. **See Fig. 1**, Ref. 5. Discard the fasteners.
   - 3.2 On axle-mounted shocks, remove the upper and lower locknuts and hardened washers. **See Fig. 2**, Refs. 4 and 5. Discard the fasteners.
4. Remove and discard the shock absorber.
5. On axle-mounted shock absorber installations, the compression sleeve (**see Fig. 2**, Ref. 3) may be rusted to the shock mounting pin and remain on the pin when the shock is removed. If this occurs, drive the sleeve off of the pin using a small, sharp chisel.
6. On axle-mounted shock absorber installations, clean the shock mounting pin threads using a stiff wire brush or, if necessary, a thread-chaser die.

   Lubricate the threads with a small amount of engine oil.
7. Install the new shock absorbers.
   - 7.1 On beam-mounted shock absorber installations, extend or compress the shock absorber as necessary to install the mounting bolts. Install the locknuts and tighten the fasteners 230 N·m (170 lbf·ft).
   - 7.2 On axle-mounted shock absorber installations, extend or compress the shock ab-



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1. Shock Absorber
2. Frame-Mounted Bracket
3. Walking Beam
4. Beam-Mounted Bracket
5. 3/4" Mounting Bolts

Fig. 1, Shock Absorbers, Beam-Mounted

Shock Absorber Replacement

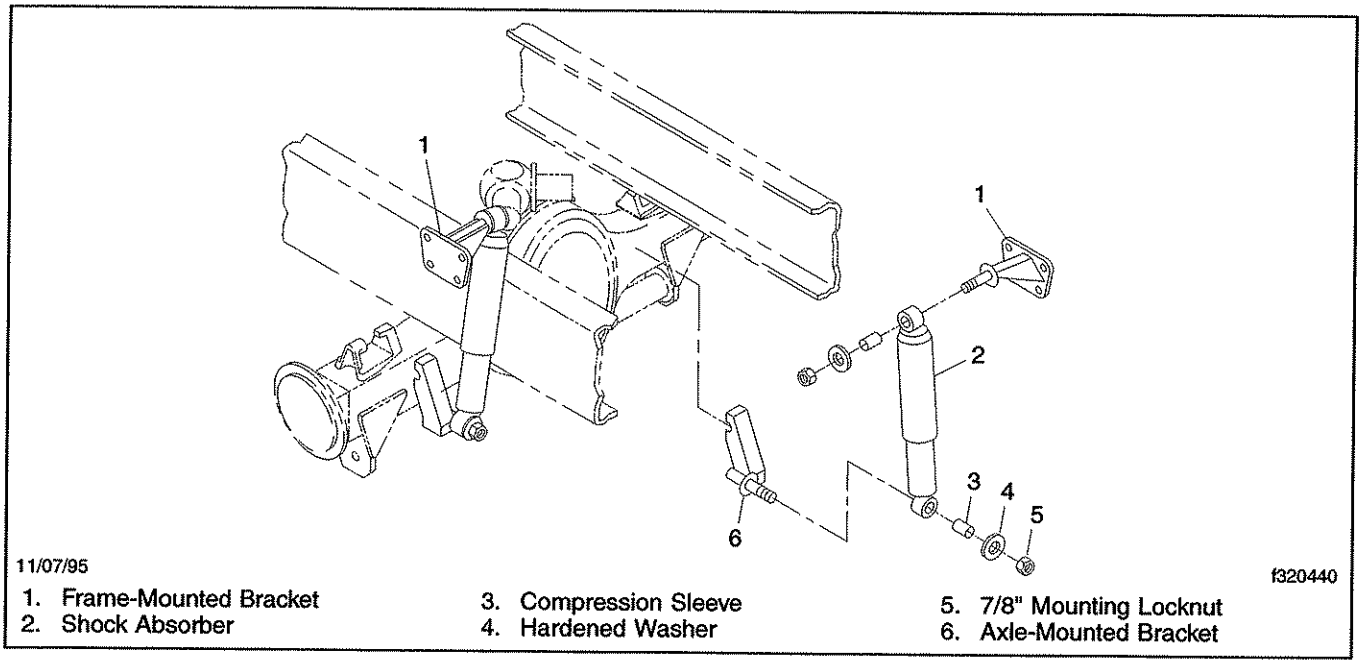


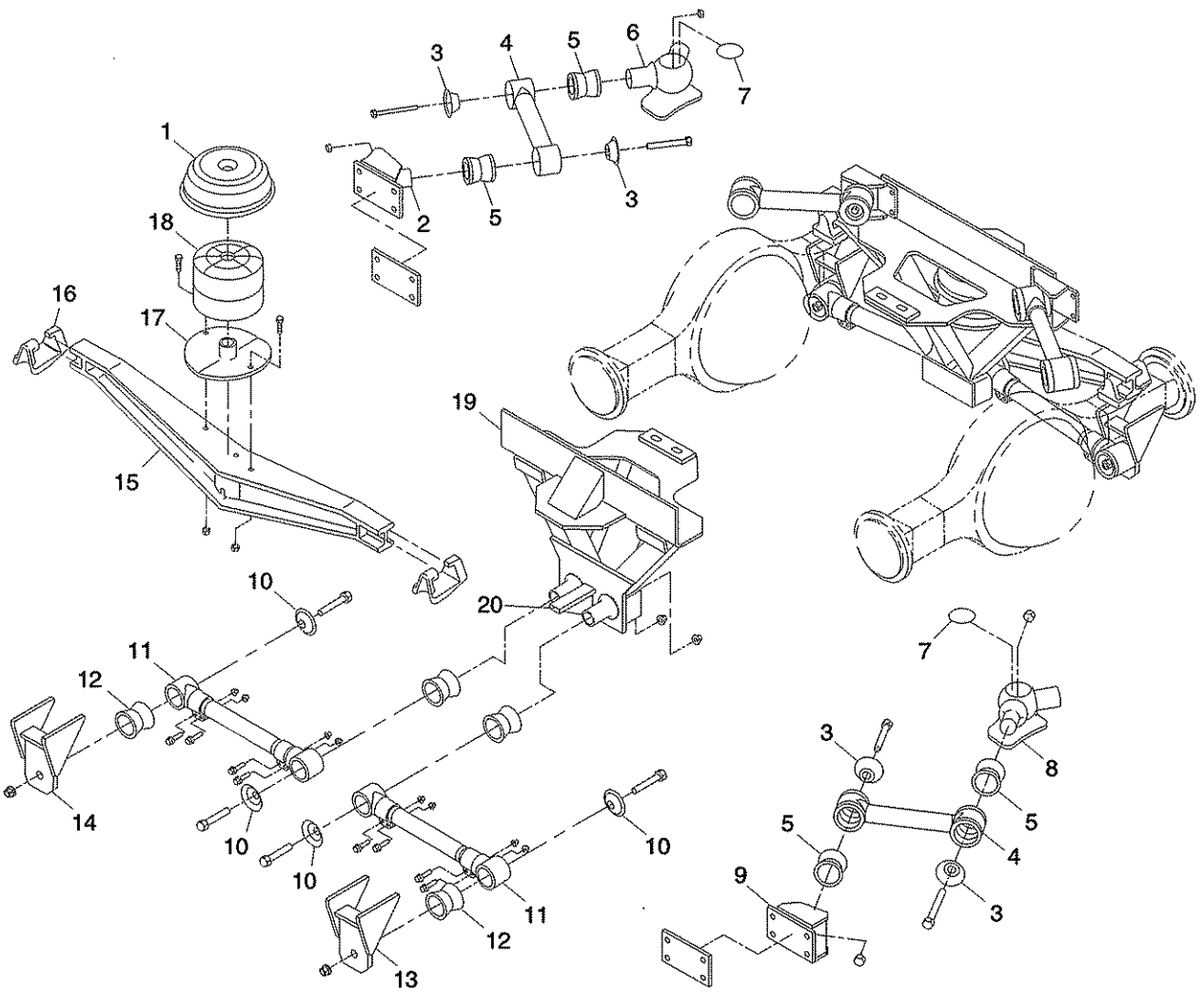
Fig. 2, Shock Absorbers, Axle-Mounted

sorber as necessary to fit it on the mounting pins. Install the locknuts and tighten them 366 N·m (270 lbf·ft).

8. Remove the chocks from the tires.

Walking Beam Removal, Inspection, and Installation

Removal (See Fig. 1)



1. Restrictor Can
2. Upper Torque Rod Frame Bracket (LH forward)
3. Spigot Cap (upper)
4. Upper Torque Rod
5. Torque Rod Bushing (upper)
6. Forward Rear Axle Tower
7. Rear Axle Tower Plug
8. Rearmost Rear Axle Tower
9. Upper Torque Rod Frame Bracket (LH rear)
10. Spigot Cap (lower)
11. Lower Torque Rod (adjustable)
12. Torque Rod Bushing (lower)
13. Lower Torque Rod Axle Housing Bracket (LH rear)
14. Lower Torque Rod Axle Housing Bracket (LH forward)
15. Beam
16. Axle Housing Beam Saddle Bracket
17. Beam Spring Plate
18. Hollow Rubber Spring
19. Sawhorse Bracket Assembly
20. Beam Stop

Fig. 1, Chalmers 800 Series Tandem Axle Suspension (40k capacity shown without shock absorbers)

Walking Beam Removal, Inspection, and Installation

1. If necessary, power wash the walking beams and axle housing ends to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Relieve all drive axle brake or wind-up loads by placing the transmission in neutral and releasing the spring or driveline brakes.
4. Raise the rear of the vehicle to remove all weight from the rear axles, and place safety stands under the frame to secure the vehicle in its raised position.
5. If equipped, disconnect beam-mounted shock absorbers from the walking beam being replaced. Refer to **Subject 120**, if necessary.
6. Remove the two bolts and nuts that secure the walking beam spring plate (**see Fig. 1**, Ref. 17) to the walking beam assembly. Discard the fasteners.

NOTE: On 54-inch spread suspensions, it may be necessary to remove the front or rear tires to allow spring assembly removal.

7. Pull the lower spring plate, rubber spring, and restrictor can as one assembly outward, off the beam assembly. **See Fig. 1**, Refs. 1, 17, 18.

NOTE: Tag or otherwise mark each torque rod to ensure that it can be re-installed in the same position and orientation.

8. Disconnect the rearmost axle's upper torque rods from the rear axle tower and the lower torque rods from the rear axle housing brackets. **See Fig. 1**, Refs. 4, 8, 11, 13.
9. Roll the rear axle rearward just enough to disengage the axle saddles (Ref. 16) from the walking beam ends.
10. Lift up the free end of the walking beam and slide the beam rearward to disengage it from the front axle saddle; remove the walking beam.

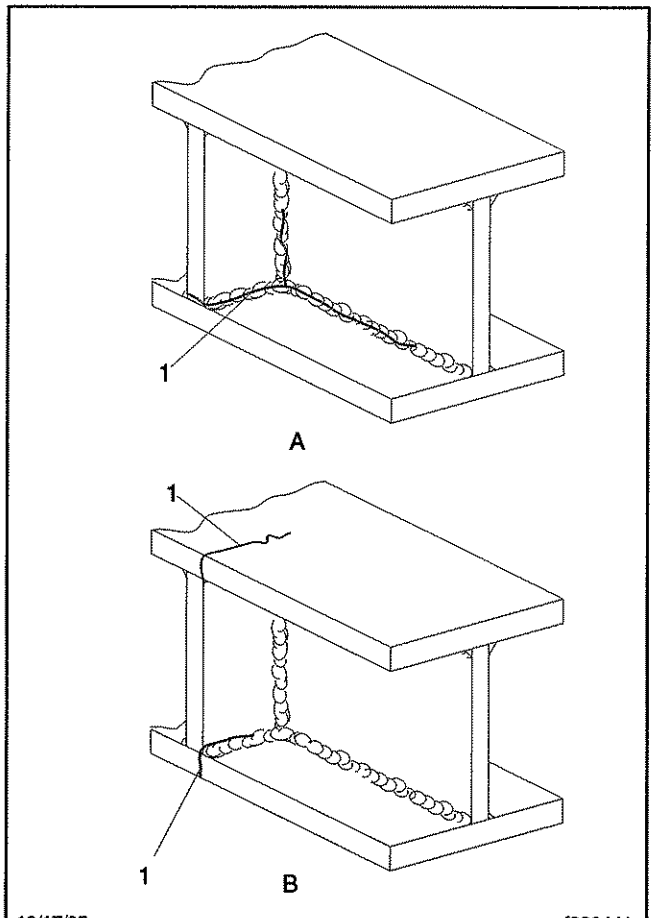
Inspection

1. Inspect the beam ends carefully, looking for cracks. Cracks along weld lines may be repairable, while cracks in or across the beam flanges require walking beam replacement. **See Fig. 2.**

NOTE: Take flange thickness measurements at least 12 mm (1/2 inch) from the flange edges. Measurements taken at the flange edges are not an accurate indication of beam wear and may lead to unnecessary beam repair/replacement.

2. Check for excessive wear on the beam flanges, where they contact the axle housing saddle brackets.

   If flange wear is significant, use a micrometer or vernier calipers to take measurements at both unworn and worn areas. The maximum allowable difference between unworn and worn areas is 1.5 mm (0.062 inch). **See Fig. 3.**



A. Repairable Walking Beam
B. Non-repairable Walking Beam
1. Cracks

Fig. 2, Repairable/Non-repairable Beam Cracks

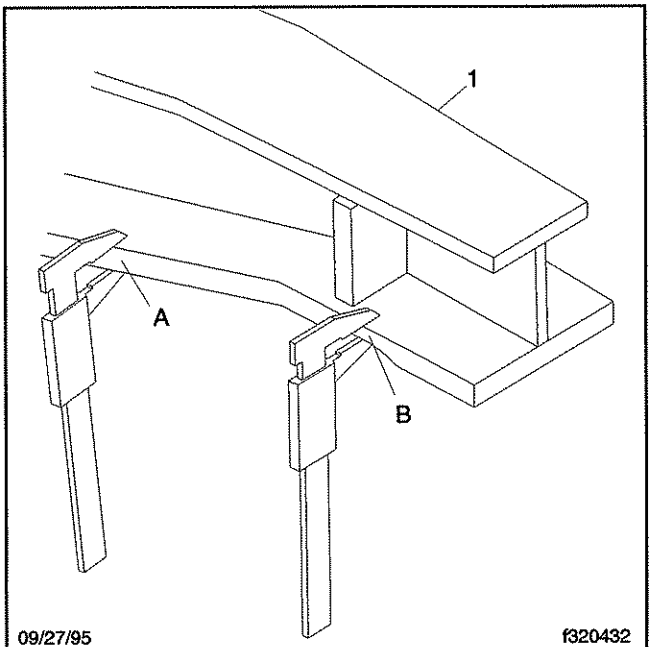
3. Beams showing excessive wear must be repaired or replaced. Refer to **Subject 140** for beam repair information.

Installation

1. Position the new or repaired walking beam over the rearmost rear axle, with the front end of the beam tilted downward.
2. Slide the beam forward and downward so the front end of the beam enters the axle housing saddle bracket. **See Fig. 4.** Let the middle of the beam rest on the sawhorse bracket beam stop.

NOTE: On 54-inch spread suspensions, it may be necessary to install the spring assembly before the rearmost axle is rolled into place.

3. Carefully roll the rearmost rear axle forward, while lifting the rear end of the walking beam enough so the beam end enters the axle housing saddle bracket.

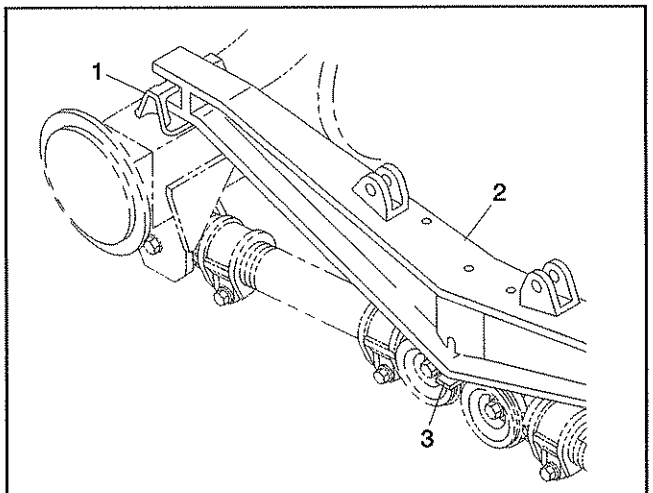


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A. Flange thickness measurement taken at unworn area for reference.
B. Flange thickness measurement taken at wear area to assess beam condition.
1. Walking Beam

Fig. 3, Beam Wear Measurement

4. Connect the rearmost axle's upper and lower torque rods to the axle housing brackets. Install and tighten the torque rod bushing through-bolts 183 N·m (135 lbf·ft).
5. Slide, as one assembly, the spring plate, rubber spring, and restrictor cap, into position on the walking beam.
6. Install and tighten the spring plate fasteners 47 N·m (35 lbf·ft).
7. If so equipped, connect the beam-mounted shock absorbers to the beam brackets and tighten the fasteners 230 N·m (170 lbf·ft).
8. Remove the safety stands from under the vehicle, then lower the vehicle.
9. Remove the chocks from the tires.



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1. Front Axle Housing, Beam Saddle Bracket
2. Walking Beam

Fig. 4, Beam/Saddle Bracket Alignment

Repair

NOTE: This subject addresses only instances where excessive beam flange wear occurs, but cracks in the web or flange are not present.

Cracked webs and/or flanges require walking beam replacement.

Walking beams with excessive flange wear, however, can be repaired by welding a Chalmers Wear Plate over the worn areas as described below.

1. Remove the walking beam assembly. Refer to **Subject 130** for information.

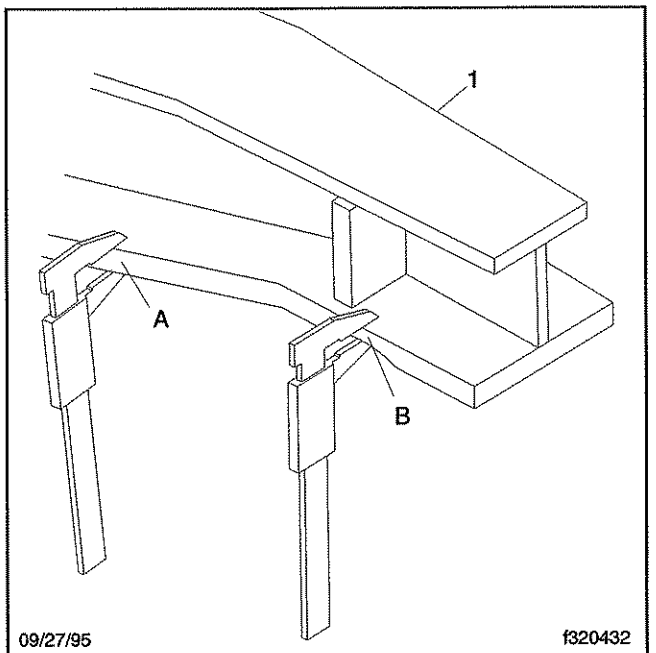
NOTE: Take flange thickness measurements at least 12 mm (1/2 inch) from the flange edges. Measurements taken at the flange edges are not an accurate indication of beam wear and may lead to unnecessary beam repair/replacement.

2. Confirm that flange wear is severe enough to warrant repairs. Use a micrometer or vernier calipers to take flange thickness measurements at both unworn and worn areas. The maximum allowable difference between unworn and worn areas is 1.5 mm (0.062 inch). **See Fig. 1.**
3. If repair is required, clean the worn area of the beam thoroughly. Make sure that any oil or grease is removed, as well as rust or road dirt accumulation. If necessary, slight grinding of the beam is allowed to smooth raised areas.
4. Clamp Chalmers Wear Plate #700313 to the bottom flange of the beam. Make sure the plate is centered and has good surface-to-surface contact with the beam. Slight grinding is allowable to obtain good plate-to-beam contact.
5. Tack weld the plate to the beam, welding on the sides of the plate only.

⚠ CAUTION

CAUTION: Weld at sides of wear plate and beam only. Never weld at the ends of the wear plate.

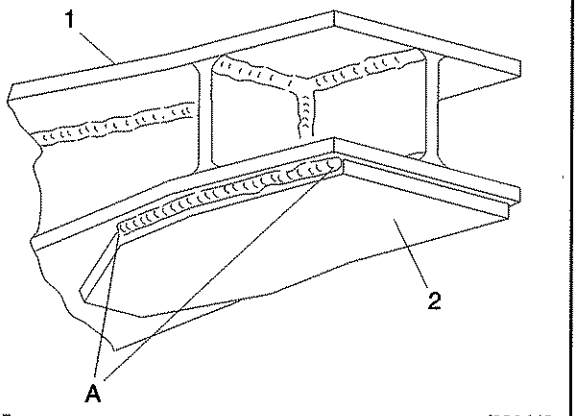
6. Remove the clamps and weld the plate to the beam, welding on the sides of the plate only. **See Fig. 2.**
7. Prime and paint the repaired area.
8. Install the repaired walking beam assembly. Refer to **Subject 130** for information.



A. Flange thickness measurement taken at unworn area for reference.
B. Flange thickness measurement taken at wear area to assess beam condition.
1. Walking Beam

Fig. 1, Beam Wear Measurement

Walking Beam Repair



A. Limit weld to this area only.
1. Walking Beam 2. Wear Plate

Fig. 2, Chalmers Wear Plate Welding

Torque Rod Removal and Installation

The torque rods hold the rear axles in place, maintaining both axle alignment and pinion nose angle. When servicing the torque rods, it is good practice to remove and install them one at a time to avoid the possibility of mixing them up and affecting the alignment or pinion nose angle.

Several different styles of torque rods and bushing spigots exist. On the 18,000 kg (40,000 lb) version of the 800 Series suspension, the torque rods have tubular steel bodies and the upper rods do not cross over one another. On the 21,000 kg (46,000 lb) version, the lower torque rods have tubular steel bodies, but the upper torque rods are made of "I-beam" shaped ductile iron. These upper torque rods do cross over one another. See **Fig. 1** and **Fig. 2.**

Removal

NOTE: Inspect torque rod bushings for free play before removing the torque rods. See **Subject 160** for torque rod bushing inspection information.

1. If necessary, power wash the rear suspension to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Relieve all drive axle brake or wind-up loads by placing the transmission in neutral and releasing the spring or driveline brakes.
4. Raise the rear of the vehicle to remove all weight from the rear axles, and place safety stands under the frame to secure the vehicle in its raised position.
5. Working on one torque rod at a time remove the torque rod bolts and spigot caps. Discard the bolts. Set the spigot caps aside for cleaning and inspection.

   Remove the torque rods by prying between the torque rod eye and the spigot base or frame bracket.

NOTE: At the axle housing towers, pry off the tower cap to access the torque rod fasteners.

6. Replace worn or damaged bushings following the instructions in **Subject 160.**
7. Inspect the spigots for damage, severe corrosion, or extensive wear. Replace damaged or severely

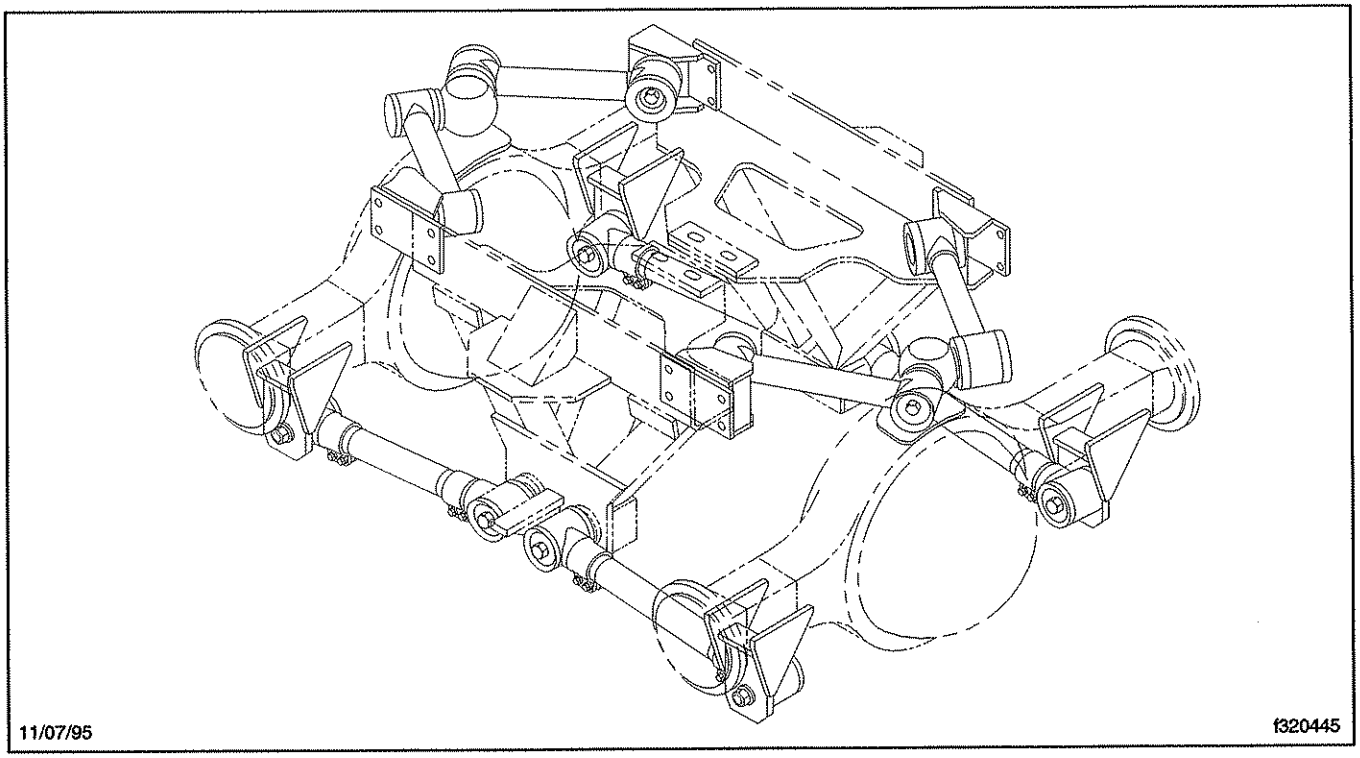


Fig. 1, Torque Rod Arrangement, 40,000 lb Capacity Suspension

Torque Rod Removal and Installation

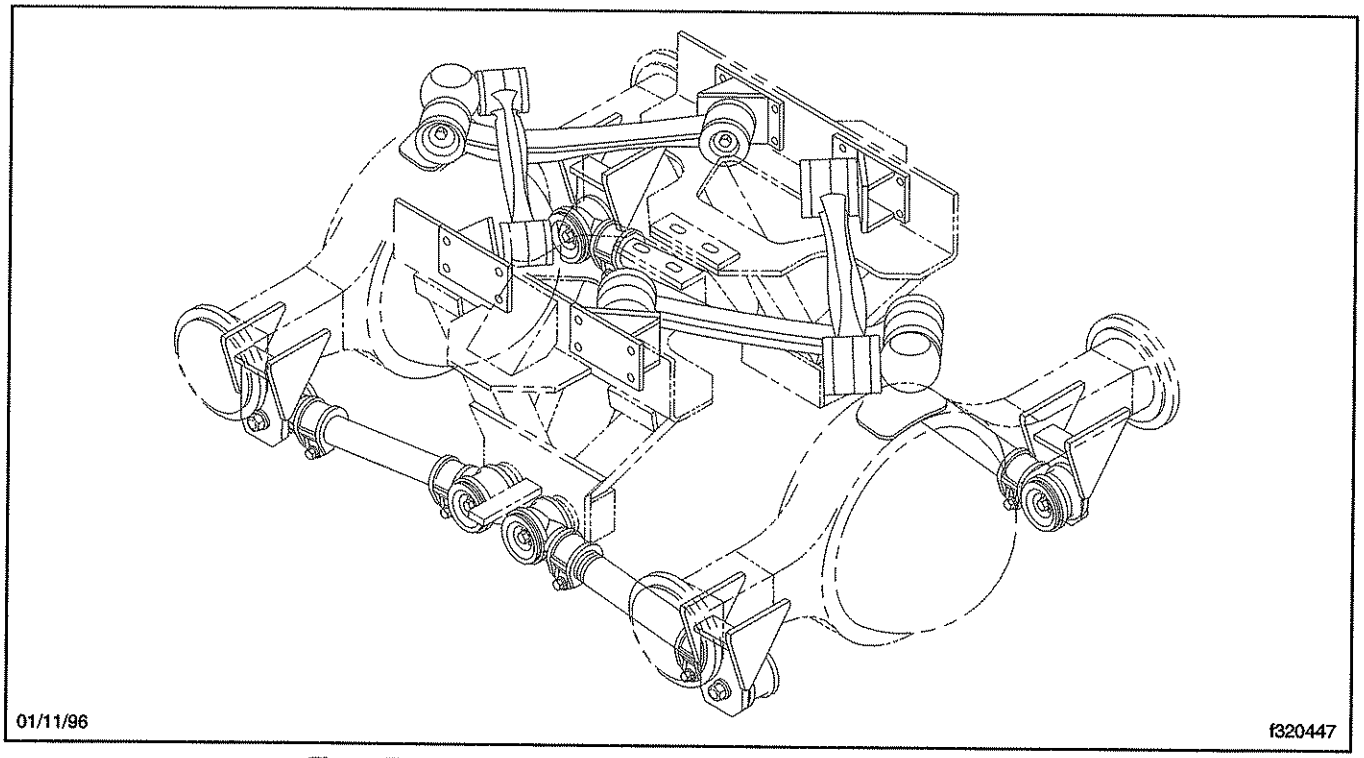


Fig. 2, Torque Rod Arrangement, 46,000 lb Capacity Suspension

corroded spigots. To determine whether or not a spigot is worn enough to warrant replacement, see **Fig. 3** and **Table 1**.

The smaller of the two measurements should be used as the spigot diameter.

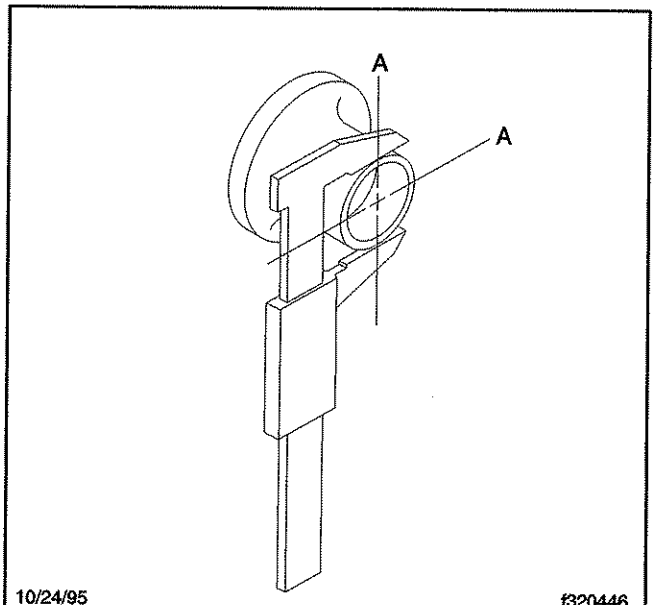
8. On vehicles equipped with Size #0 spigots, carefully inspect the spigot cap bolt head contact area for wear. A worn cap must be replaced to avoid fastener loosening. See **Fig. 4**.

Installation

1. Check the torque rod bushings to make sure they are properly installed. They must be centered within the torque rod eye. See **Fig. 5**.

IMPORTANT: Never use any mineral based oils, greases, jellies, or solvent soaps to aid in the assembly of rubber suspension parts. Use only lubricants specifically designed for use with rubber compounds.

2. Lubricate the outside of the spigots and the inside of the rubber bushings with a generous amount of rubber lubricant such as Rimslip® or equivalent.



A. Measure outside diameter at two locations, 90 degrees apart.

Fig. 3, Spigot Measurement Points

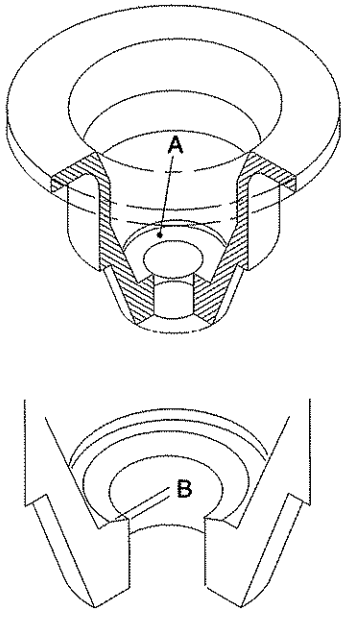
Torque Rod Removal and Installation

Spigot Size	Spigot Part No.	Useage	Minimum Spigot Diameter With Standard Bushing	Minimum Spigot Diameter With Oversize Bushing
#0	700096	40,000 lb capacity—vehicles built before 1/93	59.69 mm (2.350 in)	58.93 mm (2.320 in)
#1	800200	40,000 lb capacity—vehicles built from 1/93	59.69 mm (2.350 in)	58.93 mm (2.320 in)
#2	800021	46,000 & 50,000 lb capacity—all	64.26 mm (2.530 in)	63.50 mm (2.500 in)

Table 1, Spigot Wear Limits

3. Push the torque rod into position on its spigots. After the torque rod is partially installed, use a heavy soft-faced mallet to drive the torque rod into position until the bushing contacts the spigot bottom face.

NOTE: For easier installation, alternate mallet blows between ends of the torque rod to drive it onto the spigots evenly.

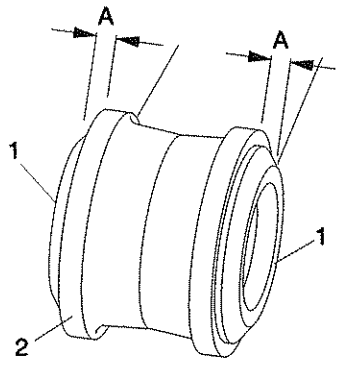


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A. The bolt head contact area is the critical wear area.
B. Wear from the bolt head must not exceed 0.127 mm (0.005") in depth

Fig. 4, Size #0 Spigot Cap Inspection Areas

4. Install the spigot caps.
5. Install and tighten the torque rod bushing through-bolts 183 N·m (135 lbf·ft).
6. Remove the safety stands from under the vehicle, then lower the vehicle.
7. Remove the chocks from the tires.



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A. The amount of rubber protruding from each side of the torque rod eye must be equal.
1. Torque Rod Bushing 2. Torque Rod Eye

Fig. 5, Torque Rod Bushing Protrusion

Torque Rod Bushing Inspection and Replacement

Inspection

1. If necessary, power wash the upper and lower torque rods to remove road dirt accumulation.
2. Chock the front tires to prevent vehicle movement.
3. Relieve all drive axle brake or wind-up loads by placing the transmission in neutral and releasing the spring or driveline brakes.
4. Using your hands only, attempt to move the torque rod ends, checking for free play. Some movement as the bushings "give" is normal, but only free play is cause for bushing replacement.

NOTE: Never use a lever or pry bar to check for torque rod bushing free play. To do so may result in unnecessary bushing replacement.

5. If free play is detected, replace the bushing as described below.

Replacement

1. Remove the torque rod containing the worn out bushing. Refer to **Subject 150**, if necessary.

NOTE: Remove only one torque rod at a time to avoid mixing-up torque rod positions.

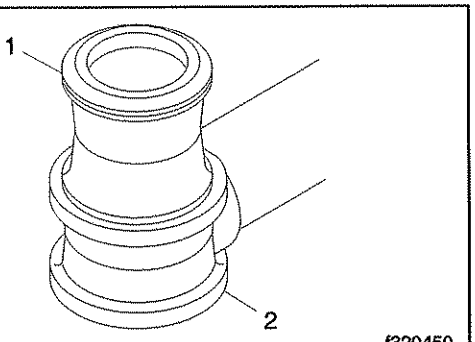
2. Place the torque rod on the floor or a workbench with a bushing open end facing upward. Push the tip of a large screwdriver down between the torque rod eye and the bushing and pry out the bushing. Discard removed bushings.
3. Use a wire brush and/or scraper to clean the torque rod eyes, removing all rust, scale, and rubber accumulations.
4. Inspect the torque rod eyes looking for cracks, distortion, or severe corrosion. Replace torque rods with damaged bushing eyes.

IMPORTANT: Never use any mineral based oils, greases, jellies, or solvent soaps to aid in the assembly of rubber suspension parts. Use only lubricants specifically designed for use with rubber compounds.

5. Lubricate both the inside of the torque rod eye and the outside of the new bushing with a generous amount of rubber lubricant, such as Rimslip® or equivalent.
6. Place the torque rod on a solid level floor with an open end of the eye facing upward. Position a lubricated bushing on the eye, making sure that the tapered shoulder of the bushing is centered on the eye. **See Fig. 1.**
7. Using a heavy, soft-faced mallet, strike the bushing squarely to drive it into the torque rod eye. Then, flip the torque rod over 180 degrees and tap on the torque rod shaft with the mallet while the bushing rests on the floor.

NOTE: If available, a small press may be used instead of a mallet for bushing installation.

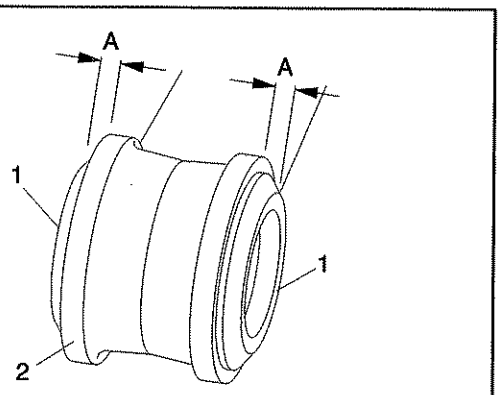
8. The bushing is completely installed when it is centered within the torque rod eye. **See Fig. 2.**
9. Install the re-bushed torque rod. Refer to **Subject 150**, if necessary.



1. Torque Rod Bushing 2. Torque Rod Eye

Fig. 1, Torque Rod Bushing Installation

Torque Rod Bushing Inspection and Replacement



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A. The amount of rubber protruding from each side of the torque rod eye must be equal .

1. Torque Rod Bushing 2. Torque Rod Eye

Fig. 2, Torque Rod Bushing Protrusion

Rear Axle Alignment Adjustment

On the Chalmers 800 Series Rear Suspension, the lower torque rods provide the only means for adjusting rear axle alignment. The upper torque rods play no part in the axle alignment process.

The lower torque rod bodies consist of steel tubes, with fine threads cut into the ends of the tube. Left-hand threads are cut into one end of the tube, right-hand threads into the other end. Therefore, by simply twisting the tube body while restraining the ends, the effective length of the tube is changed.

Two different types of torque rod ends are used. On #0 and #1 sizes, two 1/2-inch clamp bolts secure the rod ends to the tube. On the #2 size, a single 5/8-inch bolt is used. See **Fig. 1.**

Adjustment

1. Ensure that the torque rod bushings are in a fully relaxed, neutral state by slowly moving the vehicle back and forth a few times. Apply the service brakes, *not the parking brakes.*
2. Chock the front tires to prevent vehicle movement.

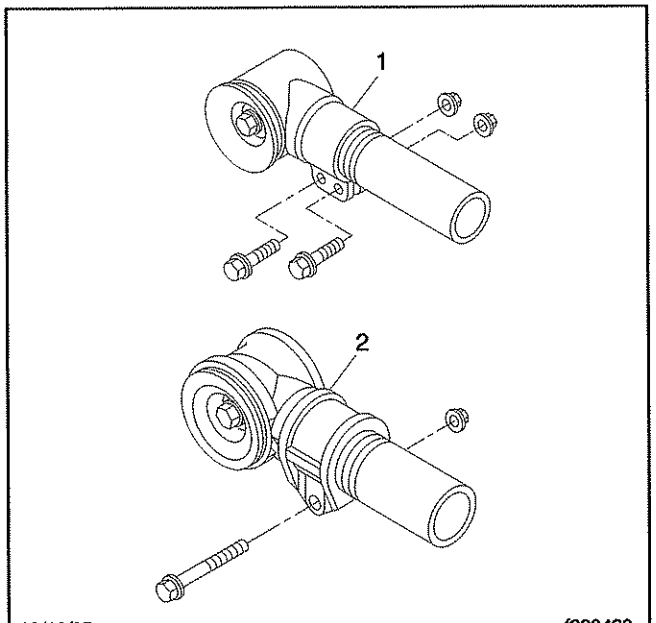


Fig. 1, Adjustable Torque Rod Ends

3. Relieve drive axle brake or wind-up loads by placing the transmission in neutral and releasing the brakes.
4. Using a straightedge and a tape measure, determine the amount of adjustment needed to align the forward-rear axle at right angles to the frame. For instructions, refer to **Group 35.** The difference in measurements between the sides of the vehicle is the approximate amount that the trailing end of the forward-rear axle will have to be brought forward, or the leading end will have to be moved back to align it at a right angle to the frame. See **Fig. 2.**

   If the forward-rear axle alignment is within specifications, go to the step that begins "Using a center-point bar, determine...".
5. On the side of the vehicle that is to be adjusted forward or rearward, loosen the torque rod end pinch bolts at both ends of the torque rod.

NOTE: If the pinch bolts are badly corroded or otherwise damaged, remove and discard them. Install new Chalmers fasteners.

6. Attach a pipe wrench to the tube body (chain type preferred) and rotate the tube to shorten or lengthen the torque rod. Continue to rotate the tube until the forward-rear axle is square to the frame.

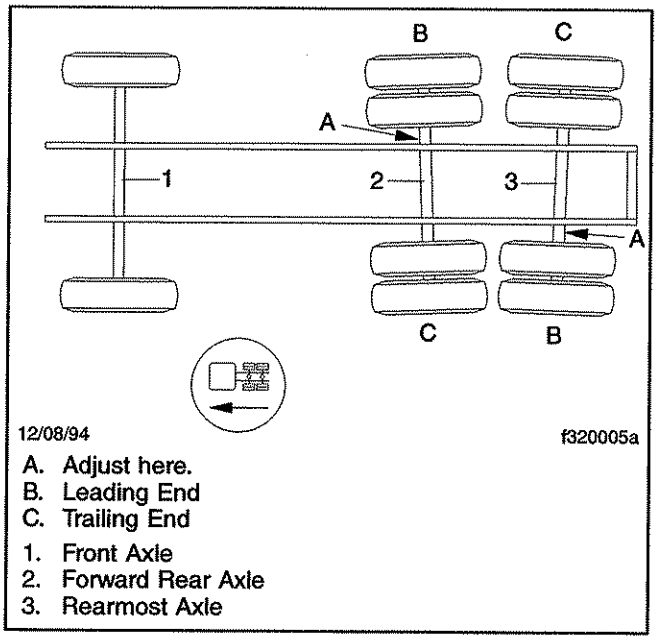
NOTE: If the torque rod tube is difficult to rotate, apply penetrating oil to the tube threads. If this does not help, remove the pinch bolts and drive wedges between the eye lugs to relieve the clamping effect.

7. When the forward-rear axle is square with the frame, tighten the pinch bolts.

   7.1 Tighten 1/2-inch UNC bolts on #0 and #1 joints 88 N·m (65 lbf·ft).

   7.2 Tighten 5/8-inch UNC bolts on #2 joints 183 N·m (135 lbf·ft).
8. Using a center-point bar, determine the difference between the forward-rear and the rearmost axles' center-to-center measurements on each side of the vehicle. For instructions, refer to **Group 35.** This difference is the approximate distance that the leading end of the rearmost axle will have to be adjusted rearward, or that the trailing end will have to be adjusted forward, to align it at a right angle to the frame, and to align it parallel to the forward-rear axle. See **Fig. 2.**

Rear Axle Alignment Adjustment



A. Adjust here.
B. Leading End
C. Trailing End

1. Front Axle
2. Forward Rear Axle
3. Rearmost Axle

Fig. 2, Tandem Axle, Shown Out of Alignment

9. On the side of the vehicle that is to be adjusted forward or rearward, loosen the torque rod end pinch bolts at both ends of the torque rod.

NOTE: If the pinch bolts are badly corroded or otherwise damaged, remove and discard them. Install new Chalmers fasteners.

10. Attach a pipe wrench to the tube body (chain type preferred) and rotate the tube to shorten or lengthen the torque rod. Continue to rotate the tube until the rearmost axle is square to the frame.

NOTE: If the torque rod tube is difficult to rotate, apply penetrating oil to the tube threads. If this does not help, remove the pinch bolts and drive wedges between the eye lugs to relieve the clamping effect.

11. When the rearmost axle is square with the frame, tighten the pinch bolts.

    11.1 Tighten 1/2-inch UNC bolts on #0 and #1 joints 88 N·m (65 lbf·ft).

    11.2 Tighten 5/8-inch UNC bolts on #2 joints 183 N·m (135 lbf·ft).

12. Remove the safety stands, and lower the vehicle. Remove the chocks from the front tires.

13. Using the center-point bar, check the rearmost axle alignment. If alignment is not within specifications, repeat the applicable steps above.

⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the suspension.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** of the *Business Class Trucks Maintenance Manual.*

Specifications

Description	Bolt Size	IFI Grade	Torque N·m (lbf·ft)
Beam Spring Plate Bolt	3/8 UNC	8	47 (35)
Torque Rod End Through Bolts	5/8 UNC	8	183 (135)
Shock Absorber (Beam-Mounted) Bolt	3/4	8	230 (170)
Shock Absorber (Axle-Mounted) Nut	7/8	G	366 (270)
#0/#1 Torque Rod End Pinch Bolts	1/2 UNC	8	88 (65)
#2 Torque Rod End Pinch Bolts	5/8 UNC	8	183 (135)

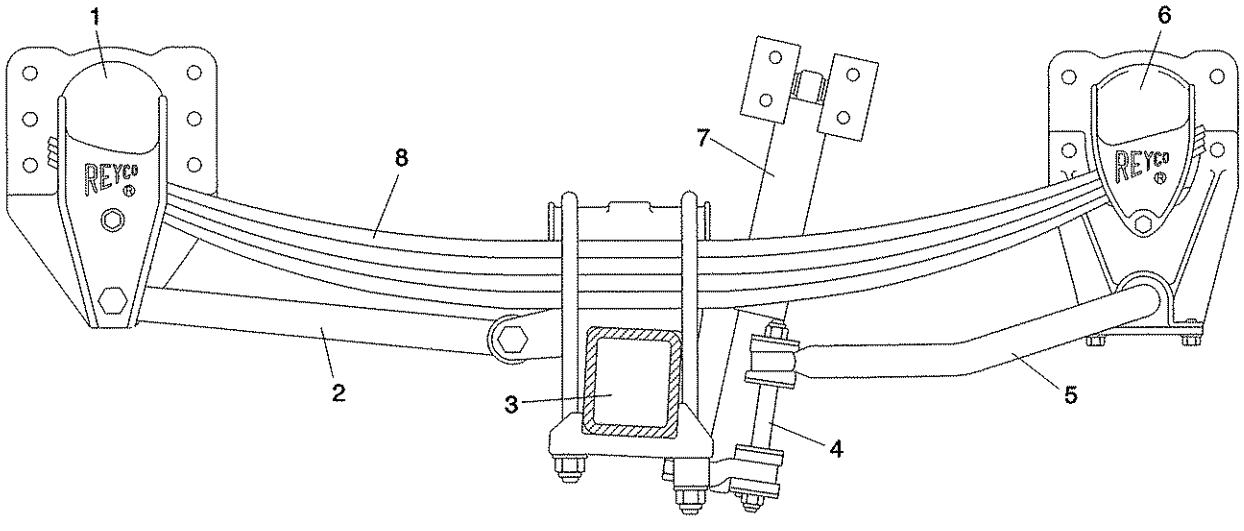
Table 1, Fastener Torques, 800 Series Suspension

Contents

Subject	Subject Number
General Description	050
Service Operations	
Torque Rod Removal and Installation	100
Spring Assembly Replacement	110
Spring Hanger Replacement	120
Rear Axle Alignment Adjustment	130
Specifications	400

General Description (See Fig. 1)

The Reyco 79KB suspension uses a full–floating spring design. Semi-elliptical spring assemblies, or optional parabolic springs, are attached to the axles with U–bolt assemblies. The spring ends ride in hangers that are mounted on the frame rails. Adjustable torque rods are attached to the forward spring hanger and axle seat to hold the axle in alignment.



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1. Forward Spring Hanger
2. Torque Rod
3. Axle
4. Anti-Sway Bar End-Link (optional)
5. Anti-Sway Bar (optional)
6. Rear Spring Hanger
7. Shock Absorber
8. Leaf Spring

Fig. 1, Reyco 79KB Suspension

Torque Rod Removal and Installation

Removal (See Fig. 1)

There are two torque rods installed on the Reyco 79KB suspension. The curb (right) side torque rod is not adjustable (rigid). The left (driver's) side torque rod is adjustable to allow proper axle alignment.

1. Apply the spring, or driveline brakes and chock the front tires.
2. Use a lifting device and raise the rear of the tractor until the rear tires are elevated above the ground. Place jack stands under the frame rails to unload the suspension, and lower the lifting device until only the jack stands are supporting the vehicle weight.
3. Place the lifting device under the axle and raise the axle to unload the torque rod. Place jack stands under the axle.
4. Remove the two torque rod bolts and nuts, and remove the torque rod. See **Fig. 1**.

Installation (See Fig. 1)

1. Place the torque rod on the forward frame hangar and install a torque rod bolt to hold it in place.
2. Raise the opposite end of the torque rod on the lower axle mounting plate.
3. Install a bolt on the torque rod
4. Tighten the torque rod locknuts 540 to 610 N·m (400 to 450 lbf·ft).
5. Raise the axle and remove the jack stands. Lower the axle to the ground.
6. Raise the rear of the vehicle and remove the jack stands. Lower the vehicle to the ground.
7. Check the axle alignment. For instructions, see **Group 35**. If necessary, adjust the rear axle alignment, using the instructions in **Subject 130**.

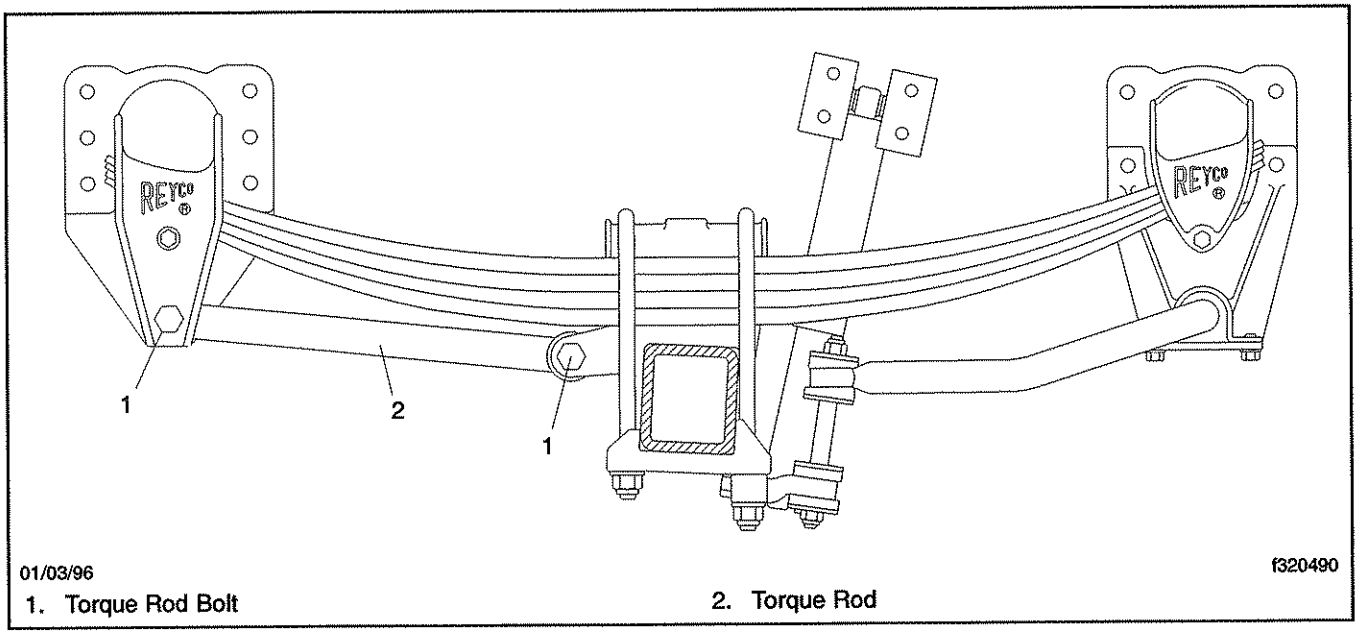


Fig. 1, Reyco 79KB Torque Rod

Spring Assembly Replacement

Removal (See Fig. 1)

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. Failure to replace a damaged spring assembly could cause an accident resulting in serious personal injury or property damage.

Leaf spring assemblies weigh approximately 100 to 190 lbs (45 to 86 kg). Do not attempt to remove a leaf spring assembly without assistance. Personal injury and property damage may result.

1. Park the vehicle on a level surface. Apply the spring, or driveline brakes and chock the front tires.
2. Raise the frame so that all weight is removed from the leaf springs, then support the frame with safety stands. Raise the rear axle until the spring no longer contacts the spring retainer rollers, then support the axle with safety stands. Make sure the stands will securely support the weight of the axles and frame. To gain easy access to the suspension system, remove the wheel assembly; see **Group 40** for instructions.
3. Remove the U-bolt locknuts and washers. Remove the U-bolt mounting plate. Remove the U-bolts, and the upper axle mounting plate.
4. Remove the spring retaining bolts, spring rollers, and nuts.
5. Use a pry tool to lift the leaf spring assembly off of the lower mounting plate.

NOTE: There is a projection at the center of the leaf spring assembly to locate the spring.

6. With assistance, carefully move the leaf spring assembly forward to clear the rear hanger. Raise the rear of the leaf spring assembly and move it rearward to clear the front hanger. Remove the leaf spring from the vehicle.

Installation

⚠ WARNING

Leaf spring assemblies weigh approximately 100 to 190 lbs (45 to 86 kg). Do not attempt to install a leaf spring assembly without assistance. Personal injury and property damage may result.

1. With assistance, position the leaf spring assembly on the axle.
2. Place the front of the leaf spring assembly through the hanger, then place the rear of the leaf spring assembly through the rear hanger.
3. Install the projection on the center of the leaf spring assembly on the spring seat.
4. Install the U-bolt pad on the leaf spring assembly.
5. Install the U-bolts over the U-bolt pad and axle tube. Insert the U-bolts through the axle clamp, then install the U-bolt washers and high nuts. Tighten the U-bolt high nuts as described in **Section 32.07, Specifications 400.**
6. Install the spring retainer bolts, rollers, and locknuts. Tighten the spring retaining bolt locknuts 60 to 80 lbf·ft (85 to 110 N·m).
7. Move the torque rod into position with the lower axle mounting plate.
8. Install the torque rod mounting bolt and locknut. Tighten the locknut 350 to 400 lbf·ft (475 to 545 N·m).
9. Install the wheel assembly. See **Group 40** for instructions.
10. Raise the axle assembly, remove the safety stands and lower the axle to the ground.
11. Raise the vehicle frame, remove the safety stands from under the frame and lower the vehicle.

⚠ CAUTION

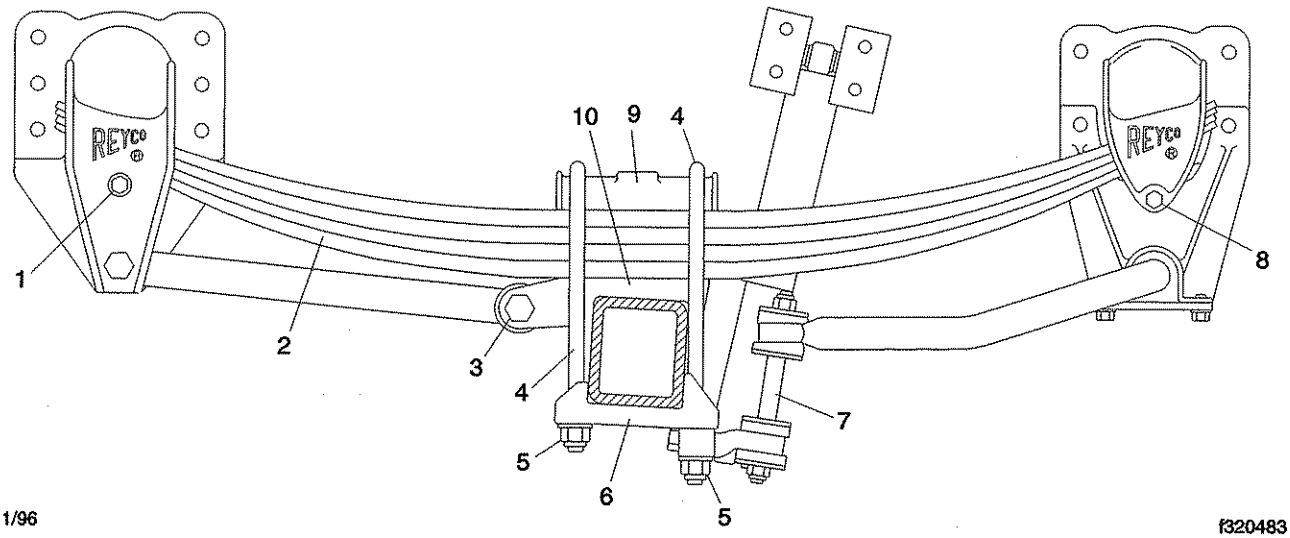
Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions,

Spring Assembly Replacement

Group 32 of the *Business Class Trucks Maintenance Manual.*

12. Check the axle alignment. For instructions, see **Group 35** in this manual. If necessary, adjust the rear axle alignment, using the instructions in **Subject 130.**



1. Forward Hanger Spring Retainer Bolt
2. Leaf Spring
3. Torque Rod Bolt
4. U-Bolt
5. U-Bolt High Nut
6. Axle Clamp
7. Anti-Sway Bar End Link (optional)
8. Rear Hanger Spring Retainer Bolt
9. U-Bolt Pad
10. Spring Seat

Fig. 1, Reyco 79KB Leaf Spring Replacement

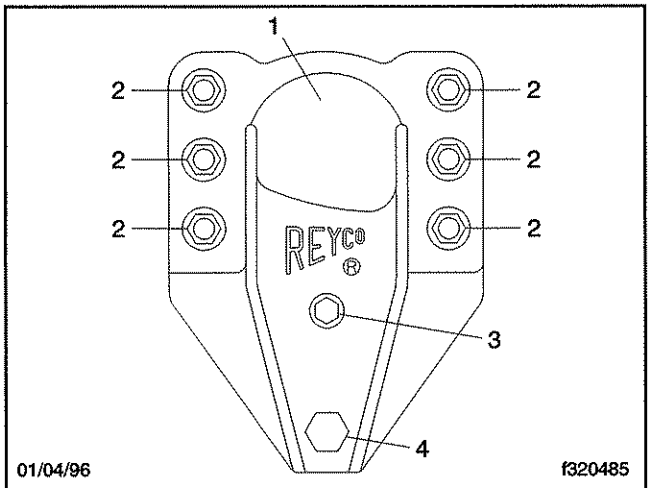
Spring Hanger Replacement

Removal

⚠ WARNING

Replace worn, cracked, or damaged spring hangers. Failure to do so could result in bracket breakage, possibly leading to loss of vehicle control and resulting in personal injury or property damage.

1. Park the vehicle on a level surface. Apply the spring or driveline brakes, and chock the front tires.
2. Place a lifting device under the vehicle frame. Lift the frame until the leaf spring assemblies are no longer in contact with the hangers, and support the frame with safety stands.
3. Remove the torque rod mounting bolt located on the forward hanger. See **Fig. 1**, Ref. 4.
4. Remove the spring retainer bolt from the forward hanger. See **Fig. 1**, Ref. 3.
5. Remove the six hanger mounting bolts and nuts. See **Fig. 1**, Ref. 2.
6. Remove the forward hanger from the frame rail.
7. Remove the spring retainer bolt from the rear hanger. See **Fig. 2**, Ref. 3.



1. Forward Spring Hanger
2. Forward Spring Hanger Mounting Bolt
3. Spring Retainer Bolt
4. Torque Rod Bolt

Fig. 1, Reyco 79KB Forward Spring Hanger

8. Remove the anti-sway bar end links, if equipped. See **Fig. 3**, Ref. 4.
9. Remove the lower spring hanger mounting bolts (see **Fig. 2**, Ref. 2) and remove the anti-sway bar mounting bracket, if equipped. See **Fig. 3**, Ref. 5.
10. Remove the upper spring hanger mounting bolts (see **Fig. 2**, Ref. 2) and remove the rear hanger.

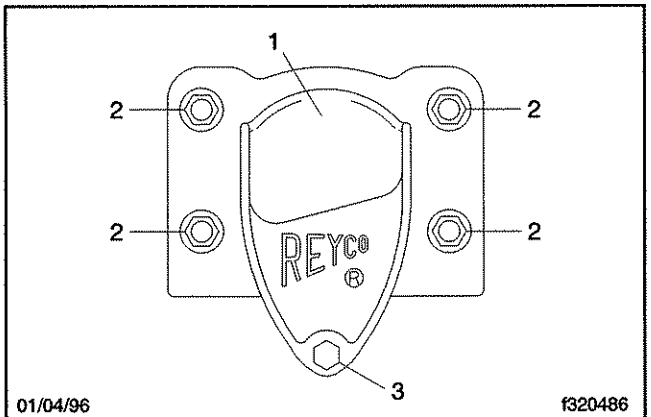
⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** of the *Business Class Trucks Maintenance Manual*.

Installation

1. Install the rear spring hanger on the frame rail, then install the two upper mounting bolts.
2. If equipped, position the anti-sway bar mounting bracket over the lower bolt holes on the rear hanger, and install the two lower mounting bolts.
3. Tighten the rear spring hanger mounting bolts 190 lbf·ft (258 N·m).



1. Rear Spring Hanger
2. Spring Hanger Mounting Bolt
3. Spring Retainer Bolt

Fig. 2, Reyco 79KB Rear Spring Hanger

Spring Hanger Replacement

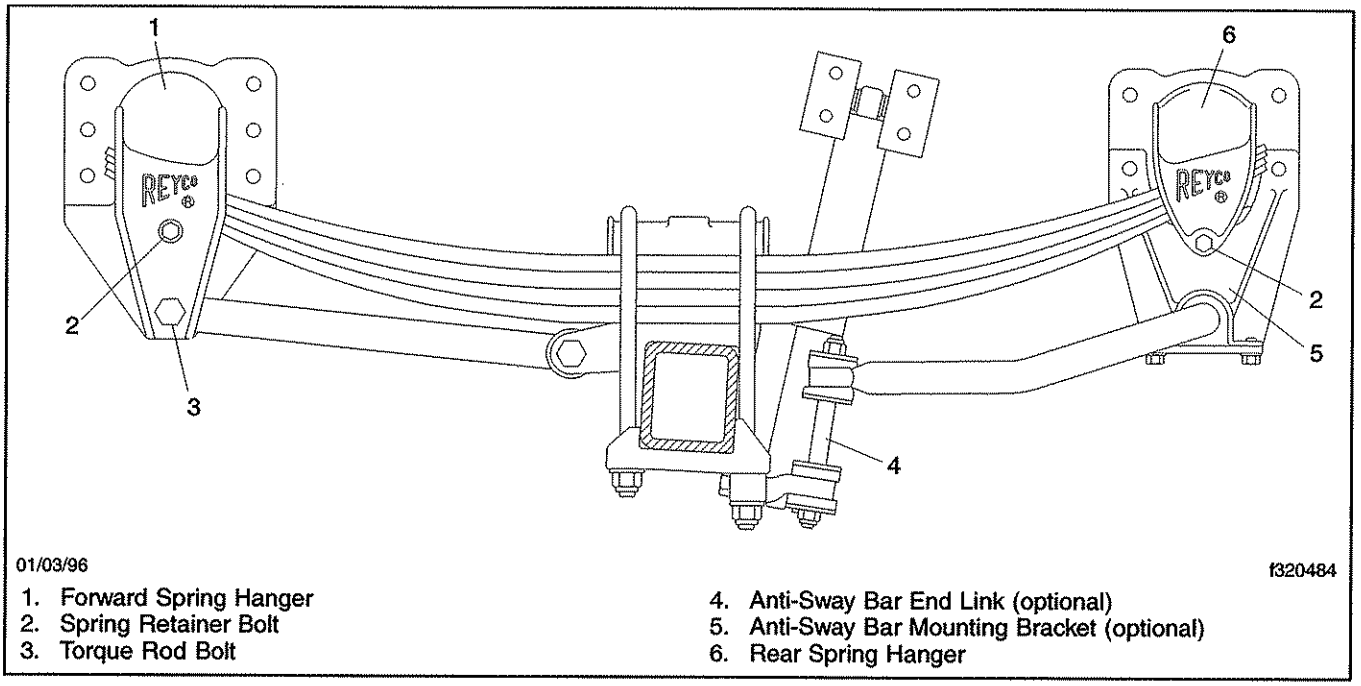


Fig. 3, Reyco 79KB Frame Hangar Components for Removal

4. Install the anti-sway bar end link and bushings, if equipped. Tighten the end link capscrew. See **Group 00** for torque specifications.
5. Install the spring retainer bolt, roller, and nut. Tighten the spring retainer bolt 60 to 80 lbf·ft (85 to 110 N·m).
6. Install the forward spring hanger on the frame rail, then install the mounting bolts. Tighten the mounting bolts 190 lbf·ft (258 N·m).
7. Install the torque rod mounting bolt. Tighten the torque rod mounting bolt 350 to 400 lbf·ft (475 to 545 N·m).
8. Install the spring retainer bolt, roller, and nut. Tighten the spring retainer bolt 60 to 80 lbf·ft (85 to 110 N·m).
9. Raise the vehicle frame with a lifting device, and remove the safety stands. Lower the vehicle to the ground.
10. Remove the wheel chocks.

Rear Axle Alignment Adjustment

Adjustment

⚠ CAUTION

Failure to periodically torque the suspension fasteners can result in abnormal tire wear, and damage to the springs, spring brackets, and frame rail.

IMPORTANT: All suspension fasteners require periodic torquing. For suspension component inspecting and fastener torque checking intervals and instructions, see **Group 32** of the *Business Class Trucks Maintenance Manual.*

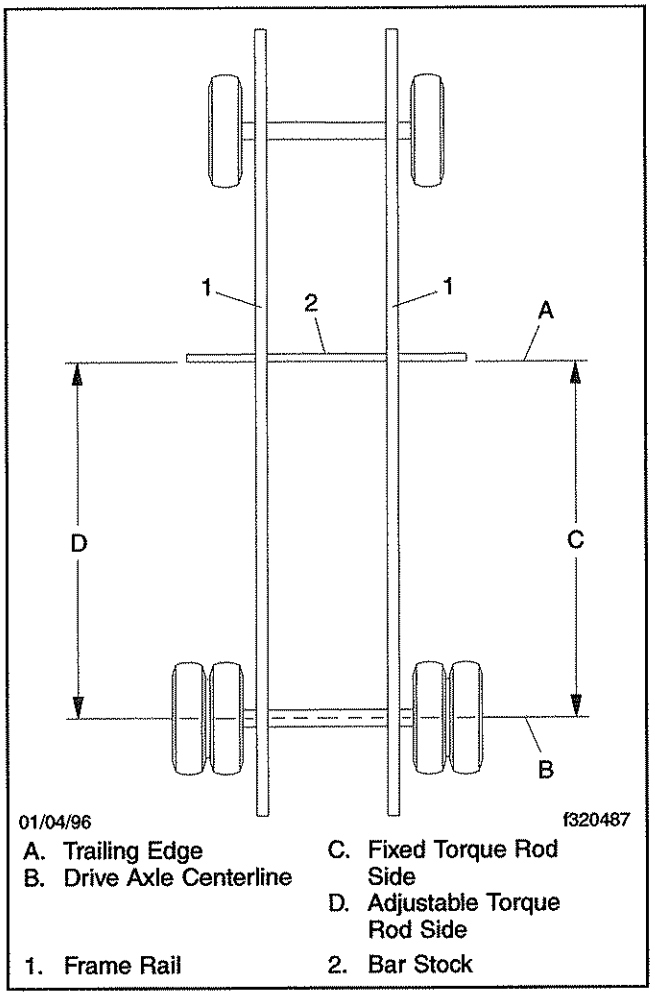
1. Park the vehicle on a level surface. Move the vehicle slowly back and forth several times without using the brakes to free all of the suspension joints. Shut down the engine. Do not apply the spring, or driveline brakes.
2. Chock the front tires.

NOTE: Check that the leaf springs are not binding in the frame hangars. Make sure that the U-bolts and torque rod bolts are torqued to specification, and all of the bushings are in good condition.

3. Position an 2-1/2 meter (8 ft) length of bar stock, or angle iron across the frame. Square the bar across the frame using a carpenter's square, and clamp it in place on the frame rail. See **Fig. 1**, Ref. 2.

NOTE: Position the bar as far forward of the drive axle as possible.

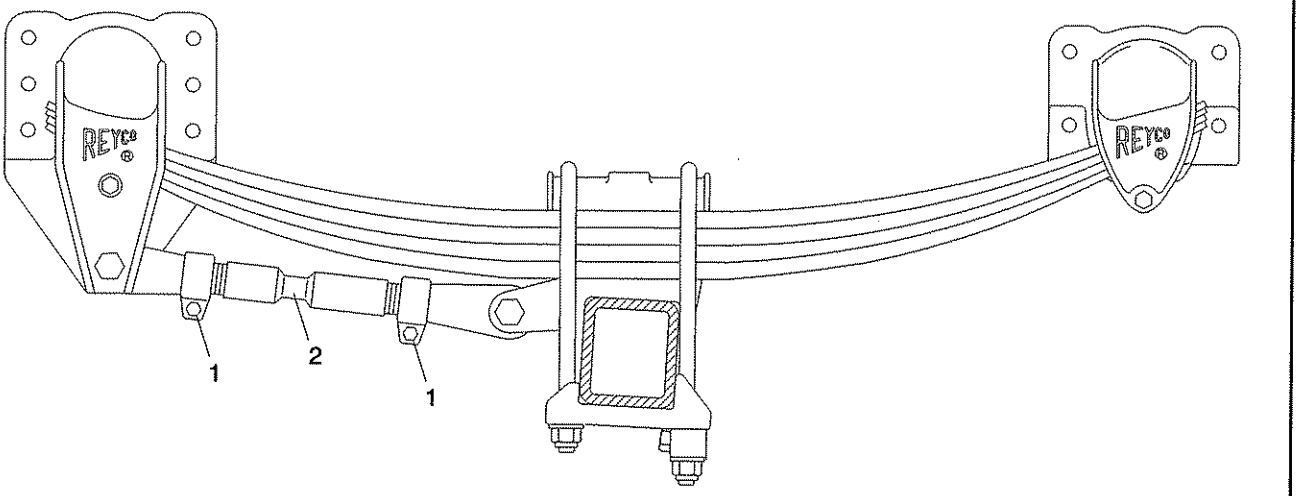
4. Start on the fixed (right) torque rod side. Measure the distance from the bar stock to the centerline of the drive axle. Repeat the same procedure on the adjustable (left) torque rod side. See **Fig. 1**, Ref. C and D.
5. If the distance varies more than 1/8-inch, alignment is necessary.
6. Loosen the torque rod clamp bolts. See **Fig. 2**, Ref. 1.
7. Use a pipe wrench or other suitable tool and slowly turn the torque rod.
8. Turn until the measurement on both sides of the axle are within 1/8-inch, then tighten the torque rod clamp bolts 170 to 203 N·m (125 to 150 lbf·ft).
9. Remove the wheel chocks and drive the vehicle through a short series of turns.
10. Recheck the alignment.



A. Trailing Edge
B. Drive Axle Centerline
C. Fixed Torque Rod Side
D. Adjustable Torque Rod Side
1. Frame Rail
2. Bar Stock

Fig. 1, Measuring Axle Alignment

Rear Axle Alignment Adjustment



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1. Torque Rod Clamp Bolt
2. Torque Rod Adjustment Location

Fig. 2, Adjustable Torque Rod

Specifications

Reyco 79KB Torque Values		
Description	**Size** **in.**	**Torque** **lbf·ft (N·m)**
Forward Spring Hanger	5/8	190 (258)
Rear Spring Hanger	5/8	190 (258)
U-bolt High Nuts	3/4–16	Stage 1: Hand tighten Stage 2: 60 (81)* Stage 3: 200 (271)* Stage 4: 270 to 330 (367 to 449)*
	7/8–14	Stage 1: Hand tighten Stage 2: 60 (81)* Stage 3: 200 (271)* Stage 4: 420 to 500 (571 to 680)*
Torque Rod Bolts	7/8	400 to 450 (545 to 615)
Torque Rod Clamp Nuts	5/8	125 to 150 (170 to 203)
Spring Retainer Bolts	1/2	60 to 80 (85 to 110)

* Tighten in a diagonal pattern as shown in **Fig. 1.**

Table 1, Reyco 79KB Torque Values

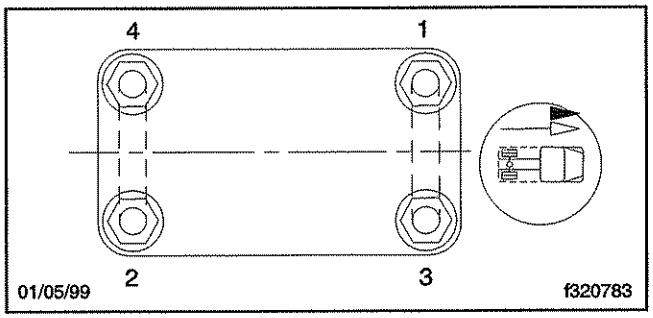


Fig. 1, Tightening Pattern for U-bolt High Nuts

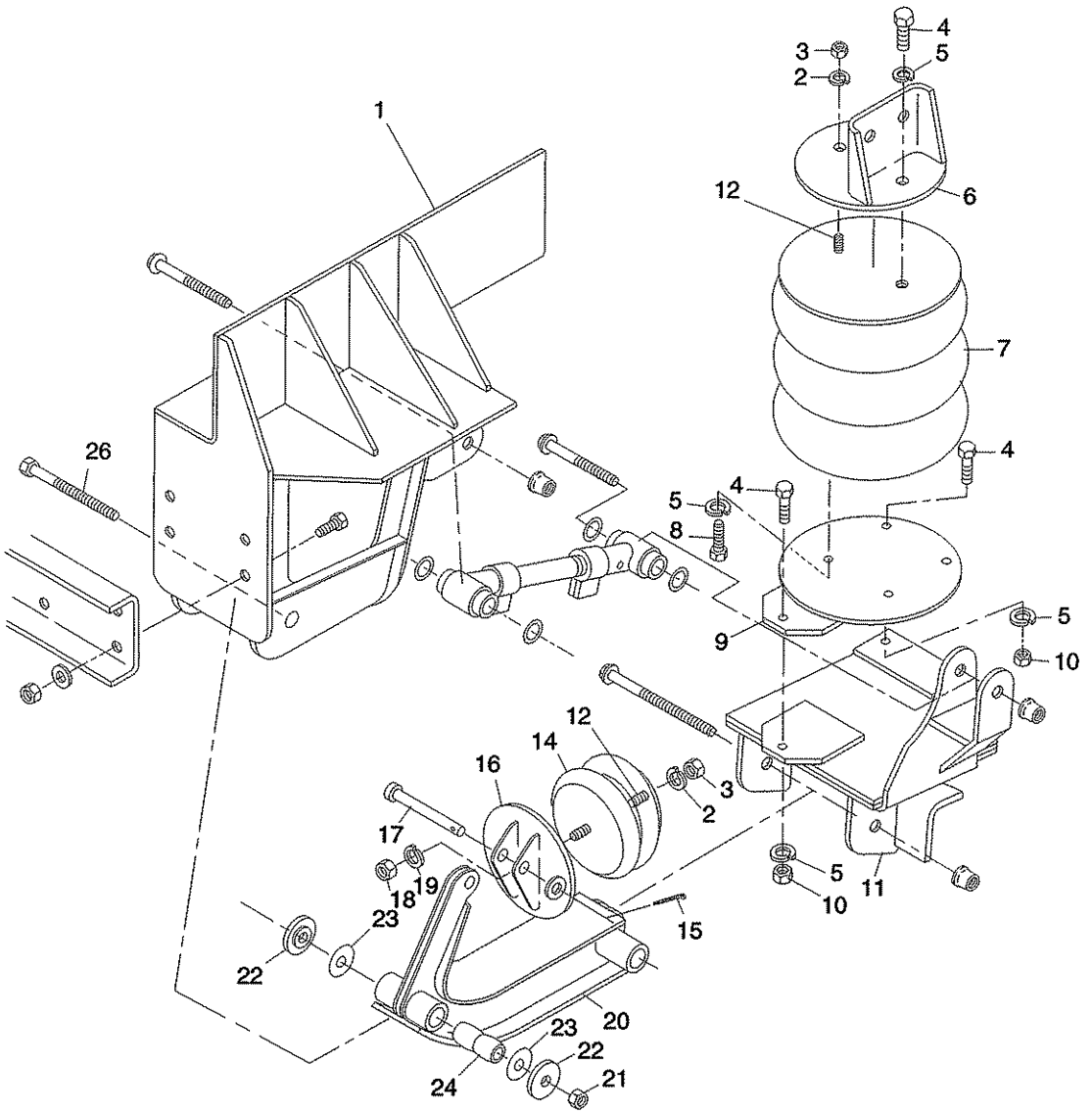
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General Description

The Watson and Chalin SL series steerable axle lift suspension (**Fig. 1**) uses a full-floating air spring design. Two air springs are attached to a trailing arm assembly. One air spring controls the suspension riding height, depending on load requirements, and the other air spring is used to lift the axle assembly when not in use. The trailing arm and air springs are attached to the frame rail with an upper torque rod, and a fastener that rides on a rubber bushing. Weld collars locate the suspension on the frame and hold the axle in alignment.

General Description



1. Side Rail Assembly
2. 3/4-Inch Lockwasher
3. 3/4-Inch UNF Hexnut
4. 3/8 x 1-1/8 Inch Capscrew
5. 3/8-Inch Lockwasher
6. Upper Air-Spring Plate
7. Load-Bearing Air Spring
8. 3/8-Inch UNC x 1 Inch Capscrew
9. Lower Air-Spring Plate
10. 3/8-Inch UNF Hexnut
11. Axle Pad Assembly
12. Air Fitting
13. Flatwasher
14. Axle Lift-Air Spring
15. Cotter Pin
16. Lift Plate
17. 3/4-Inch Clevis Pin
18. 1/2-Inch UNC Hexnut
19. 1/2-Inch Lockwasher
20. Trailing Arm
21. 1-1/8-Inch Locknut
22. Weld Collar
23. Washer
24. Bushing

Fig. 1, Air Spring Replacement, Exploded View

Upper Torque Rod Removal and Installation

Removal (See Fig. 1)

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the tires.
2. Completely drain all of the air from the air system. The air pressure gauge should read 0 psi (0 kPa).

⚠ WARNING

WARNING: Failure to drain the air system could result in personal injury, or property damage.

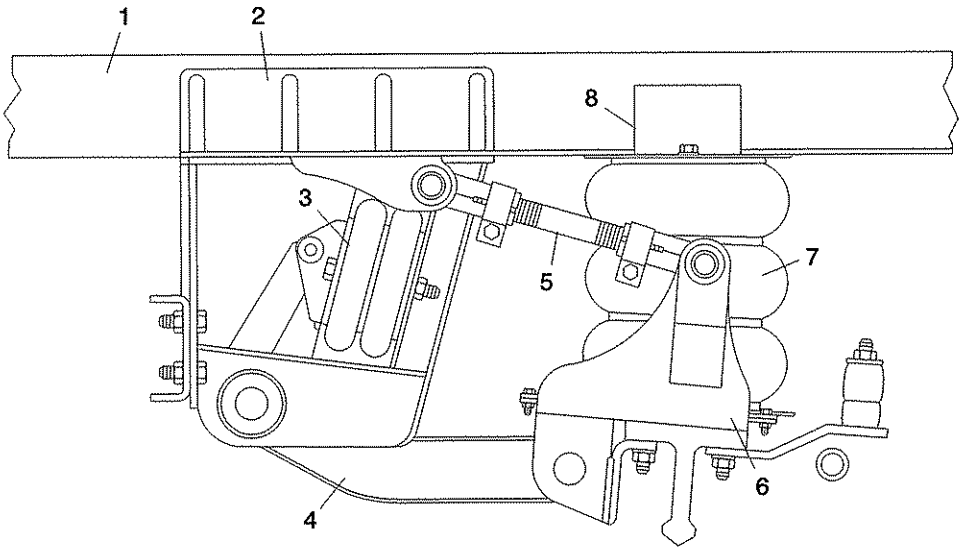
NOTE: If the upper torque rod has been previously serviced, remove the two mounting capscrews, two nuts, and four washers that attach the upper torque rod to the frame rail and axle assembly.

3. Remove the two huck bolts, two huck collars, and four washers that attach the upper torque rod to the frame rail and axle assembly.
4. Remove the upper torque rod from the vehicle.

Installation (See Fig. 1)

1. If you are replacing the upper torque rod, measure the length of the old upper torque rod.
2. Duplicate the measurement, as closely as possible, on the new upper torque rod.
3. Install the upper torque rod onto the frame rail and axle assembly using the two capscrews, four washers, and two locknuts. Do not tighten the upper torque rod clamps.

   Use a pipe wrench to align the upper torque rod to the frame hanger and the axle pad assembly.
4. Tighten the capscrew at the frame rail 600 lbf·ft (814 N·m).
5. Tighten the capscrew at the axle assembly 1000 lbf·ft (1356 N·m).
6. Connect a magnetic protractor to the steerable axle.
7. Position the protractor on the axle pad assembly, so it is even with the centerline of the axle and the axle spindle center. See **Fig. 2**, Ref. 2.



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1. Frame Rail
2. Side Rail Assembly
3. Axle-Lift Air Spring
4. Trailing Arm
5. Torque Rod
6. Axle Pad Assembly
7. Load-Bearing Air Spring
8. Upper Air-Spring Mounting Plate

Fig. 1, Watson and Chalin SL Series Steerable Axle Lift Suspension

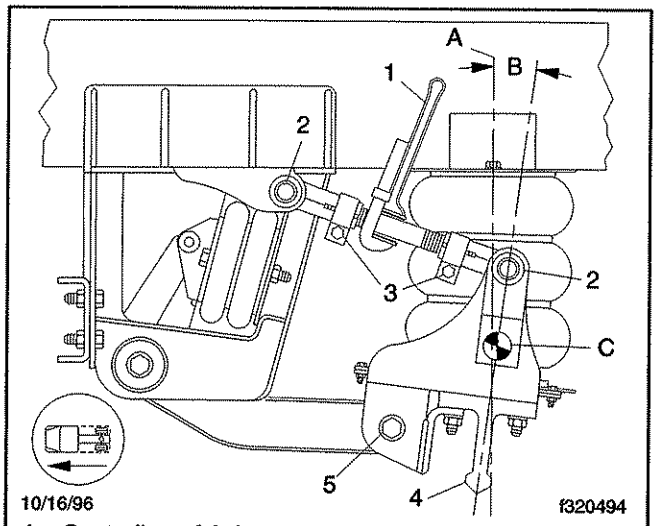
Upper Torque Rod Removal and Installation

8. Move the protractor to position the centerline of the axle with the centerline of the upper torque rod capscrew. See **Fig. 2**, Ref. 6.
9. Record the caster setting. See **Fig. 2**, Ref. A.

NOTE: Check both wheels for proper caster settings.

Caster should be set at 5° to 6° positive. Caster cannot be less than 5° positive.

10. If the caster setting is incorrect, adjust by turning the upper torque rod clockwise, or counterclockwise to achieve the proper caster setting. See **Fig. 2**, Ref. 1.
11. Tighten the upper torque rod clamps 600 lbf·ft (814 N·m).
12. Check the toe-in of the axle, using instructions found in **Group 33.**



A. Centerline of Axle
B. Caster Setting
C. Axle Spindle Center
1. Pipe Wrench
2. Huck Collar
3. Upper Torque Rod Clamp
4. Steerable Axle
5. Axle Seat Capscrew

Fig. 2, Watson & Chalin SL Series Suspension, Adjusting Caster

Air Spring Inspection and Replacement

Inspection (See Fig. 1)

Check the air springs periodically to ensure that there is no dry-rot, cracking, deformities, or other damage that could impede the performance of the vehicle. Refer to the driver's manual for additional information regarding daily, pre-trip inspections of the air springs.

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the tires.
2. Check the air bags for cracks, deformities, dry-rotting, or other damage. Replace the air bags as needed.
3. Check for obstructions that could cause a breach of the air bag integrity. Reposition any component that is making contact with the air spring.
4. Check that the air system is fully charged, then check the operation of the axle lift air spring. If the axle lift air springs do not operate properly, refer to **Subject 300** for troubleshooting information.
5. Check the air lines for cracks, deformities, or leaking. Replace the air lines as needed.

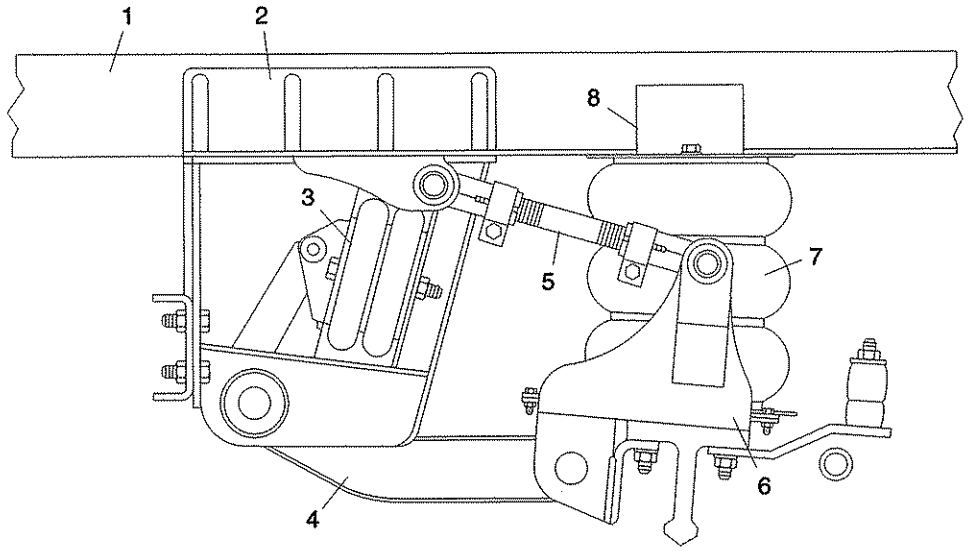
Replacement (See Fig. 2)

⚠ WARNING

WARNING: Before attempting to remove the air springs, be sure that all of the air has been drained from the air system. The air spring will expand, suddenly, when removed from its mount if the air system is not fully drained and could result in personal injury, or property damage.

Axle Lift Air Spring

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the wheels.
2. Completely drain all of the air from the air system. The air pressure gauges should read 0 psi (0 kPa).
3. Use a lifting device and elevate the steerable axle.
4. Place jack stands under the axle beam.
5. Remove the cotter pin, washer, and clevis pin from the lift plate.
6. Remove the air line and fitting from the axle lift air spring.

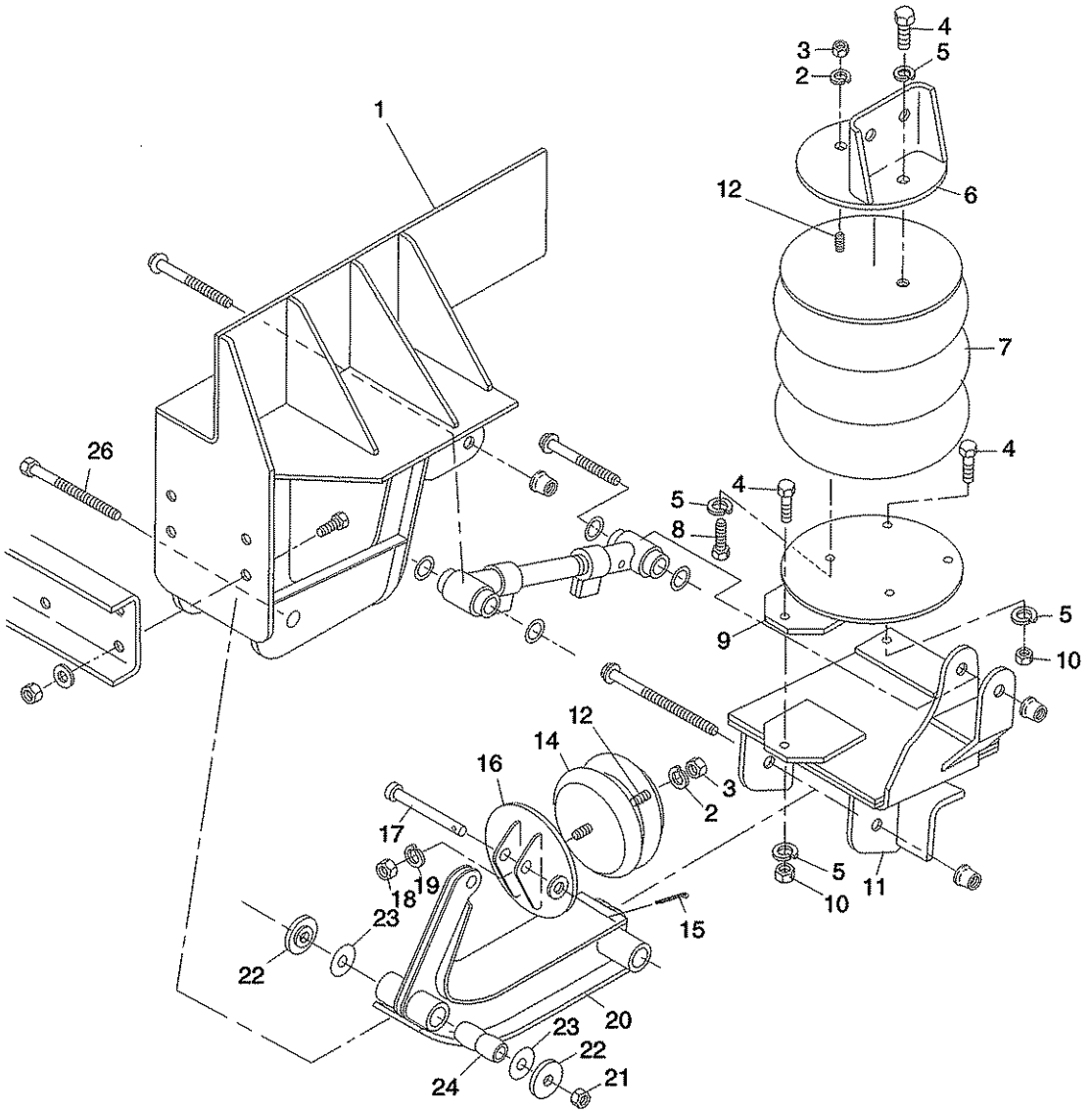


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1. Frame Rail
2. Side Rail Assembly
3. Axle-Lift Air Spring
4. Trailing Arm
5. Torque Rod
6. Axle Pad Assembly
7. Load-Bearing Air Spring
8. Upper Air-Spring Mounting Plate

Fig. 1, Watson & Chalin SL Series Steerable Axle Lift Suspension

Air Spring Inspection and Replacement



1. Side Rail Assembly
2. 3/4-Inch Lockwasher
3. 3/4-Inch UNF Hexnut
4. 3/8 x 1-1/8 Inch Capscrew
5. 3/8-Inch Lockwasher
6. Upper Air-Spring Plate
7. Load-Bearing Air Spring
8. 3/8-Inch UNC x 1 Inch Capscrew
9. Lower Air-Spring Plate
10. 3/8-Inch UNF Hexnut
11. Axle Pad Assembly
12. Air Fitting
13. Flatwasher
14. Axle Lift-Air Spring
15. Cotter Pin
16. Lift Plate
17. 3/4-Inch Clevis Pin
18. 1/2-Inch UNC Hexnut
19. 1/2-Inch Lockwasher
20. Trailing Arm
21. 1-1/8-Inch Locknut
22. Weld Collar
23. Washer
24. Bushing

Fig. 2, Air Spring Replacement, Exploded View

7. Remove the capscrew, two washers, two washers, and one locknut then lower the trailing arm.
8. Remove the 3/4-inch hexnut and washer; then remove the axle lift air spring.

9. Remove the 1/2-inch hexnut and lockwasher from the lift plate; then separate the axle-lift air spring (Ref. 14).
10. Install the axle-lift air spring on the lift plate. Install the 1/2-inch hexnut and lockwasher on the lift plate. Tighten the hexnut 25 lbf·ft (34 N·m).
11. Install the new axle-lift air spring, lockwasher, and 3/4-inch hexnut on the frame hanger. Tighten the hexnut 200 lbf·ft (271 N·m).
12. Raise the trailing arm and insert the clevis pin through the lift plate; then insert and lock a new cotter pin into the clevis pin.
13. Start the capscrew (Ref. 26) through the frame hanger (Ref 1). Position the washers between the frame hanger and the lower trailing arm and the trailing arm. Install the capscrew through the frame hanger and the trailing arm. Install the locknut and tighten it 1000 lbf·ft (1356 N·m).
14. Install the air fittings and the air lines.
15. Remove the jack stands.
16. Start the engine and build up air pressure.
17. Check for air leaks, and check axle lift operation.
18. Remove the chocks from the tires.

Load Bearing Air Spring

⚠ WARNING

WARNING: Before attempting to remove the air springs, be sure that all of the air has been drained from the air system. The air spring will expand suddenly when removed from its mount if the air system is not fully drained. This could result in personal injury or property damage.

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the tires.
2. Completely drain all of the air from the air system. The air pressure gauges should read 0 psi (0 kPa).
3. Remove the air line and fitting.
4. Remove the 3/4-Inch hexnut and lockwasher (Refs. 2 and 3) from the upper air-spring plate.
5. Remove the 3/8-inch capscrew and lockwasher (Refs. 4 and 5) from the upper air-spring plate.
6. Remove three 3/8-inch capscrews, hexnuts, and three lockwashers (Refs. 4, 5 and 10) from the rear of the axle pad assembly.
7. Place a pry tool between the upper air-spring plate and the load bearing air spring.
8. Pull down on the pry tool to separate the air spring from the mounting plate, and remove the air spring from the vehicle.
9. Remove two 3/8-inch capscrews and two lockwashers that secure the lower air-spring plate to the air spring. Separate the lower air-spring plate from the air spring.
10. Check the upper and lower air-spring plates for signs of corrosion, cracks, or other damage. Replace any air-spring plate that appears damaged, or excessively corroded.
11. Install the lower air-spring plate on the air spring.
12. Apply a light coating of Loctite® 242 to the threads of the capscrews. Install the capscrews on the air spring and tighten 15 lbf·ft (20 N·m).
13. Install the air spring on the upper air-spring plate and center the lower air-spring plate capscrew holes on the axle pad assembly.
14. Install the three 3/8-inch capscrews, three lockwashers, and three hexnuts on the lower air spring plate. Tighten the capscrews 15 lbf·ft (20 N·m).
15. Install the 3/8-inch x 1-1/8 inch capscrew and lockwasher on the upper air-spring plate. Tighten the capscrew 15 lbf·ft (20 N·m).
16. Install the 3/4-inch hexnut and lockwasher on the upper air-spring plate. Tighten the hexnut 200 lbf·ft (271 N·m).
17. Install the air fitting, then connect the air line to the air springs.
18. Start the engine and build up air pressure. Check for air leaks and repair as needed. See **Subject 300** for troubleshooting information.
19. Shut down the engine and remove the chocks from the tires.

Inspection

Air pressure must be maintained in excess of 80 psi (552 kPa) to operate the brake protection valve. The brake protection valve maintains air brake pressure in the event of an air loss in the suspension system.

⚠ WARNING

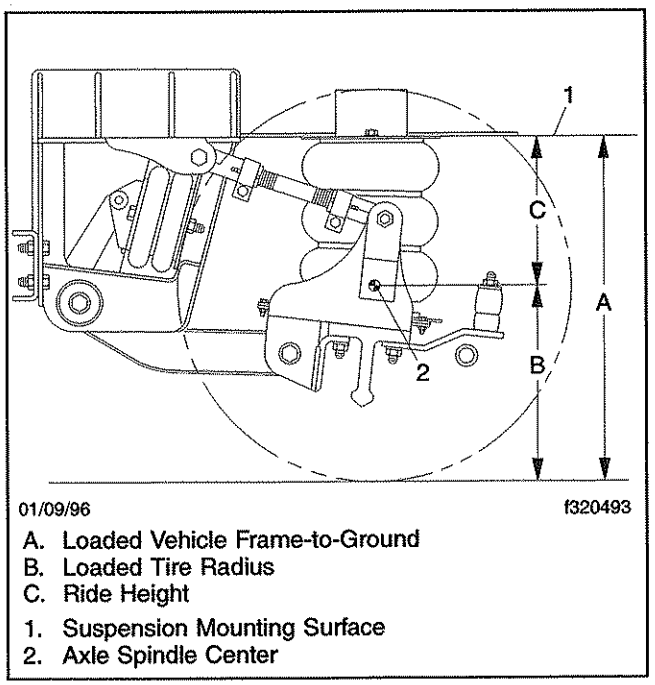
WARNING: Maintain air pressure of 80 psi (552 kPa). Failure to do so could result in brake failure if the suspension system suffered an air loss. This could result in personal injury or property damage.

Suspension ride height is defined as the distance between the suspension mounting surface and the spindle center of the auxiliary liftable axle. See **Fig. 1**.

Suspension ride height must be calculated with the vehicle in its loaded condition.

To check the ride height of the Watson & Chalin SL Series Suspension, use the following formula: A (loaded vehicle frame-to-ground) – B (loaded tire radius) = C (Ride Height).

1. Take the loaded frame-to-ground measurement (See **Fig.1**, Ref. A); the distance from the bottom of the frame rail to the ground, with the vehicle in a loaded condition.
2. Measure the loaded tire radius (See **Fig. 1**, Ref. B); the distance from the axle spindle center to the ground, with the vehicle in a loaded condition.
3. Subtract the loaded tire radius from the loaded frame-to-ground measurement to determine ride height (See **Fig. 1**, Ref. C).



A. Loaded Vehicle Frame-to-Ground
B. Loaded Tire Radius
C. Ride Height
1. Suspension Mounting Surface
2. Axle Spindle Center

Fig. 1, Watson & Chalin SL Series Suspension, Calculating Ride Height

Adjustment

The Watson & Chalin SL series steerable axle lift suspension ride height is set at the factory. Ride height can be adjusted only by altering the air pressure to the air springs. The amount of air pressure varies depending on vehicle load. Refer to **Specifications 400**, for load-to-pressure specifications.

Inspection

The Watson & Chalin SL series steerable-axle lift suspension is operated from a control panel consisting of an air pressure gauge, pressure regulator, and a double-pull, double-throw air valve. See **Fig. 1**.

The control panel is designed so the driver can regulate the load pressure in the air springs for the proper, or desired load on the auxiliary axle. It is also designed to lift the auxiliary axle to the UP position when the vehicle load is empty, or the auxiliary axle is not required.

Optionally, an automatic reverse lift can be installed to automatically lift the suspension when the vehicle is shifted into reverse. An automatic reverse lockout will automatically lock the steerable axle to prevent it from turning when the vehicle is shifted to reverse. See **Fig. 2**.

1. Park the vehicle on a level surface. Apply the parking brakes, and chock the front tires.
2. Start the engine and build up air pressure in excess of 80 psi (552 kPa).

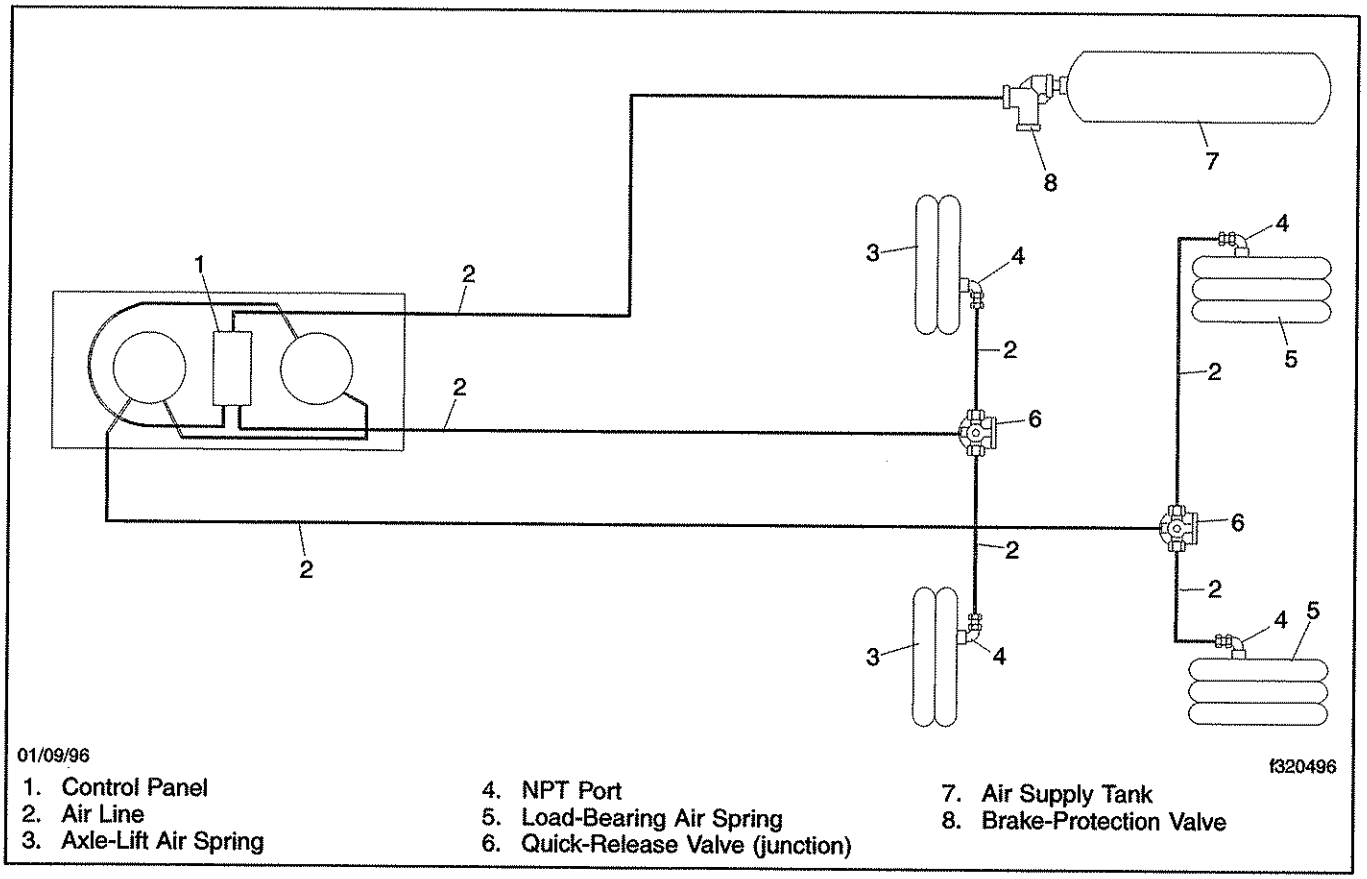
⚠ WARNING

WARNING: Maintain air pressure of 80 psi (552 kPa). Failure to do so could result in brake failure if the suspension system suffered an air loss. This could result in personal injury or property damage.

3. Shut down the engine.
4. With a mixture of soap and water, coat the air fitting on the load bearing air springs, axle lift air springs, and at each air line junction.
5. If an air leak exists, air bubbles will form around the area where the leak originated. Repair or replace any leaking air line, fitting, or junction as needed.
6. Inspect the air supply tank for excessive corrosion, dents, or other damage that could weaken the tank. Replace any air supply tank that's damaged.
7. On vehicles equipped with an automatic reverse lift, check the solenoids for proper operation.
   - 7.1 Start the engine and lower the auxiliary axle suspension.
   - 7.2 Shift the transmission to reverse and check the position of the auxiliary axle.

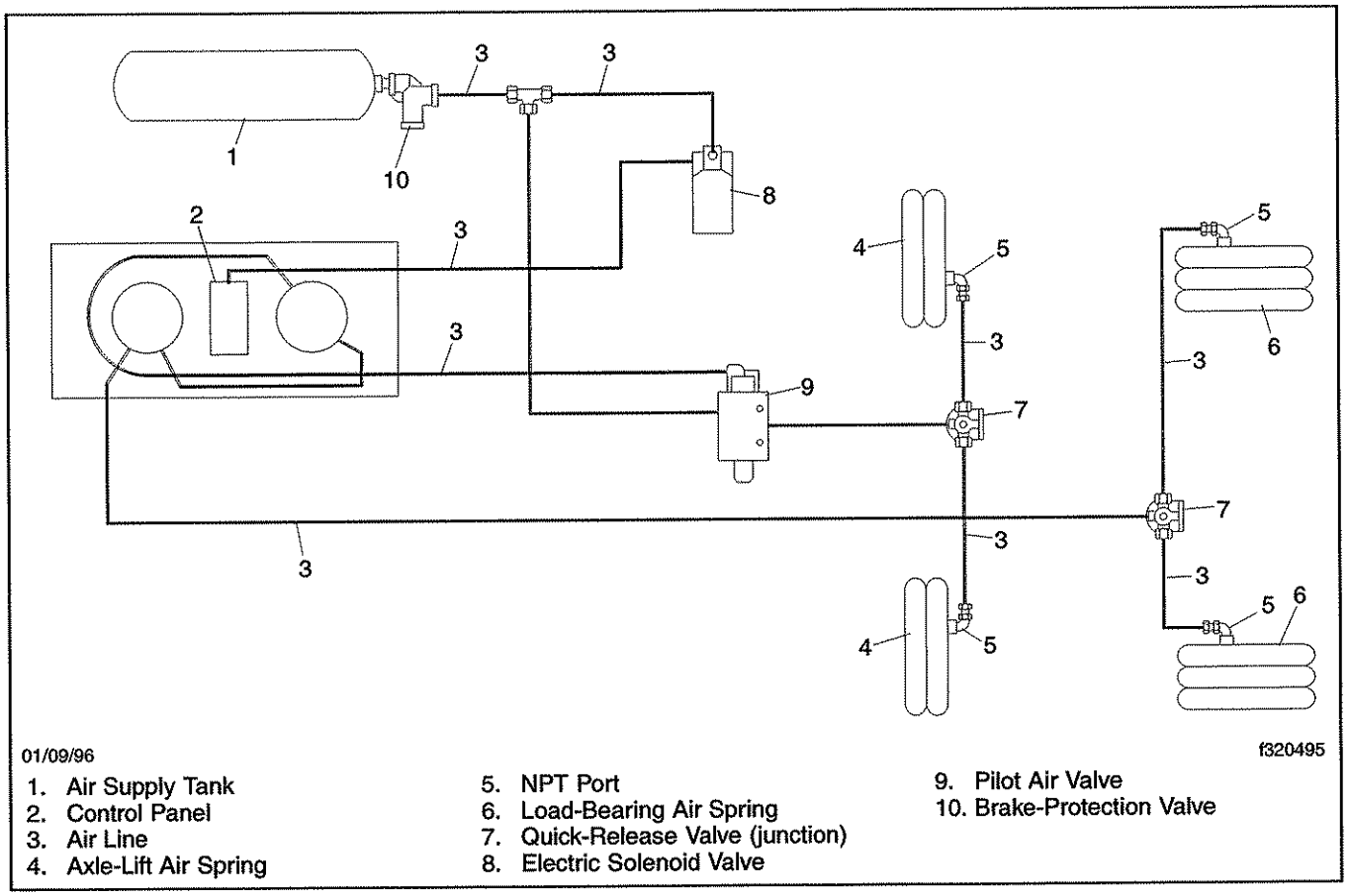
   NOTE: When the shifter is placed in reverse, the steering will lock in a straight-ahead position, and the axle will lift off the ground.
8. If the axle does not lift, shut down the engine and use the following instructions.
   - 8.1 Turn the ignition key ON, but do not start the engine.
   - 8.2 Disconnect the harness connector from the reverse lock-out solenoids.
   - 8.3 With a voltmeter, probe the harness side of the connector. There should be no voltage with the shifter in neutral or any forward gear.
   - 8.4 Do not start the engine. Move the shifter into reverse, and recheck for voltage. When the shifter is in reverse gear there should be 11 to 13 volts at the solenoid. If no voltage is found, trace and correct a short to ground in circuit 120B.
9. Check the air springs for cuts, dry-rotting, deformities, or other damage. Replace the air springs as needed. Refer to **Subject 110**, for replacement instructions.

Air System Inspection



1. Control Panel
2. Air Line
3. Axle-Lift Air Spring
4. NPT Port
5. Load-Bearing Air Spring
6. Quick-Release Valve (junction)
7. Air Supply Tank
8. Brake-Protection Valve

Fig. 1, Watson and Chalin Suspension with Standard Air Control



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1. Air Supply Tank
2. Control Panel
3. Air Line
4. Axle-Lift Air Spring
5. NPT Port
6. Load-Bearing Air Spring
7. Quick-Release Valve (junction)
8. Electric Solenoid Valve
9. Pilot Air Valve
10. Brake-Protection Valve

Fig. 2, Watson and Chalin Suspension with Automatic Reverse Lockout

Problem–Not Getting the Desired Load on Steerable Axle

Problem–Not Getting the Desired Load on Steerable Axle	
Possible Cause	**Remedy**
Incorrect air pressure to load the air springs.	Increase or decrease air pressure at regulator valve.
Air control system not properly installed.	Check piping of air system.
Mounted too high.	Shim axle area. May require lower trailing arm replacement.

Problem–Insufficient Air Pressure to Steerable Axle System

Problem–Insufficient Air Pressure to Steerable Axle System	
Possible Cause	**Remedy**
Damaged brake protection valve or air compressor.	Replace brake protection valve and check air compressor.

Problem–Steerable Axle Not Getting the Correct Lift

Problem–Steerable Axle Not Getting the Correct Lift	
Possible Cause	**Remedy**
Axle lift air springs not getting proper air pressure.	Check system pressure, and check air system piping.
Interference with chassis, driveline, or other chassis components.	Check for interference, and correct as needed.
Unit not properly installed.	Check installation.
Lower trailing arm being restricted from full retraction.	Contact Watson & Chalin.

Problem–Steerable Axle is Steering in Opposite Direction from Truck

Problem–Steerable Axle is Steering in Opposite Direction from Truck	
Possible Cause	**Remedy**
Improper caster setting.	Adjust caster.

Problem–Steerable Axle has Vertical Hop

Problem–Steerable Axle has Vertical Hop	
Possible Cause	**Remedy**
Insufficient air pressure.	Increase air pressure.
Excessive road vibration.	Install vertical shock kit.

Load-to-Pressure Ratings for SL–1100–SR Suspension			
Load at Ground lb (kg)	Run Height 10 Inches psi (kPa)	Run Height 11 Inches psi (kPa)	Run Height 12 Inches psi (kPa)
5000 (2268)	29 (200)	31 (214)	34 (234)
6000 (2722)	37 (255)	39 (269)	43 (297)
7000 (3175)	44 (303)	47 (324)	52 (360)
8000 (3629)	52 (360)	56 (386)	60 (414)
9000 (4082)	60 (414)	64 (441)	69 (476)
10,000 (4536)	67 (462)	72 (496)	78 (538)
11,000 (4990)	75 (517)	80 (552)	87 (600)
12,000 (5443)	82 (565)	88 (607)	96 (662)
13,000 (5897)	90 (621)	97 (669)	105 (724)
14,000 (6350)	98 (676)	105 (724)	114 (786)

Table 1, Load-to-Pressure Ratings for Watson & Chalin SL-1100-SR Suspension

Torque Specifications for Watson & Chalin SL–1100–SR Suspension	
Size in.	Torque Rating lbf.ft (N.m)
1/4	5 (7)
3/8	15 (20)
1/2	25 (35)
5/8	150 (205)
3/4	200 (270)
7/8	550 (745)
1	600 (815)
1-1/8	1000 (1355)

Table 2, Bolt Torque Specifications for Watson & Chalin SL-1100-SR suspension

Wheel Caster and Toe-In Specifications		
Item	Minimum Setting	Variable
Caster	+5°	+1°
Toe-In	+1/32-Inch (+0.8 mm)	±1/32-Inch (±0.8 mm)

Table 3, Wheel Caster and Toe-In Specifications

Contents

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General Information

The AirLiner Plus suspension is used on vehicles with pusher or tag axles to improve traction performance.

The system maintains an accurate leveling of frame height through the use of the Rockwell WABCO ECAS (Electronically Controlled Air Suspension) system with sensors and an electronic control unit. A height sensor mounted between the frame and the drive axle housing provides the ECAS control unit with frame height information. Other sensors provide additional information, which the control unit uses to quickly lower or raise the frame height as necessary. The operation occurs while the vehicle is in motion or while parked.

The vehicle must be equipped with a rear axle air suspenion, and requires ABS with Automatic Traction Control to trigger the optional load transfer function automatically.

AirLiner Plus components include:

- A cab-mounted electronic control unit that uses information about the vehicle's rear frame height to adjust the air pressure of the air spring bags;
- A frame rail-mounted solenoid valve that adjusts the air pressure;
- An axle- and frame-mounted height sensor that provides the control unit with frame-height information;
- A brake light switch that informs the control unit when the brakes are applied;
- A dash-mounted warning light that indicates a system fault;
- A load transfer light that displays automatic load transfer status;
- A three-position dash switch that allows automatic load transfer, driver-activated load transfer, or no load transfer.
- An optional hand-held remote control unit that is used to alter the chassis height for loading and unloading.

System Operation

Indicator Lights

ECAS FAIL: Lights for approximately two seconds when the ignition key is turned on, then the light goes out and remains out during vehicle operation. If the ECAS FAIL light does not go out after two seconds, or if it comes on during vehicle operation, there is a failure in the ECAS system.

LOAD X-FER: Lights for approximately two seconds when the igition key is turned on, then the light goes out. Lights whenever there is a manual or an automatic load transfer.

Frame Height Control

ECAS will maintain the vehicle frame to a pre-set height within a 3/16-inch (5 mm) range. The optional remote control unit allows frame height adjustment within operating limits if the vehicle is parked or moving less than 7 mph.

Load Transfer Activation

If the load weight is transferred from the tag axle to the drive axle, it will remain shifted for 20 seconds and is then slowly transferred back to a normal condition. The complete load cycle takes approximately 45 seconds.

Slippage of the driving wheels (usually when starting out on a slick surface) will activate the automatic load transfer. The load transfer will activate after the Automatic Traction Control activates.

Pressing the MOM ON (momentary on) side of the LOAD X-FER dash switch will activate the load transfer system. Manual activation works, however, only at vehicle speeds less than 30 mph.

Load Transfer Termination

The load transfer cycle will immediately terminate if the service brakes are applied when the vehicle speed is more than 30 mph, when the STOP button on the remote control (if equipped) is pressed, or when the vehicle speed exceeds 75 mph.

The STOP button on the remote control will terminate the load transfer at any speed.

ECU Removal and Installation

Removal

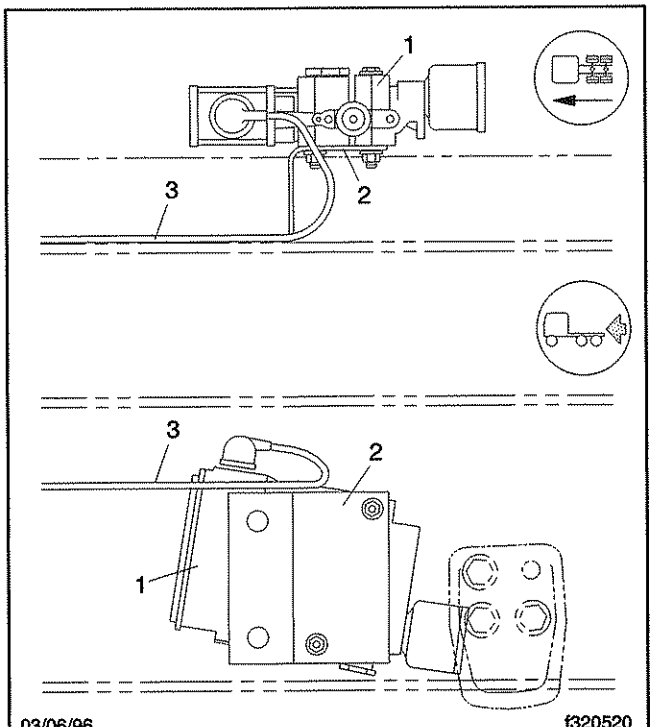
1. Shut down the engine and set the parking brake.
2. Chock the front tires.
3. Remove the lower cover at the base of the left B-pillar.
4. Disconnect the electrical connections at the base of the B-pillar.
5. Remove the grab handle.
6. Remove the shoulder harness adjustable D-loop mechanism mounted to the B-pillar.
7. Detach the plastic channel that attaches the upholstery to the door frame. This will provide slack in the upholstery to allow access to the ECU mounted inside the B-pillar.
8. Remove the fasteners that attach the B-pillar upholstery to the cab wall.
9. Reach inside the B-pillar and remove the fasteners that attach the ECU.
10. Disconnect the electrical connections on the unit, and remove the ECU from the B-pillar.

Installation

1. Install the ECU inside the B-pillar. Connect the electrical connections.
2. Install the B-pillar upholstery.
3. Attach the plastic channel around the door frame and upholstery.
4. Install the shoulder harness adjustable D-loop mechanism.
5. Install the grab handle.
6. Connect the electrical connections at the base of the B-pillar.
7. Install the lower panel at the base of the B-pillar.
8. Remove the chocks from the tires.

Replacement

1. Shut down the engine and set the parking brake.
2. Chock the front tires.
3. Drain air from the suspension system.
4. At the ECAS solenoid valve (see **Fig. 1**), which is mounted to the frame rail, disconnect the electrical connector.
5. Mark the air lines for later reference.
6. Disconnect the air lines from the solenoid valve.
7. Remove the two bolts attaching the solenoid valve to the valve bracket.
8. Remove the valve from the bracket.
9. Attach the new valve to the bracket. Install the bolts.
10. Connect the air lines to the valve as marked earlier.



1. Solenoid Valve
2. Bracket
3. Wire

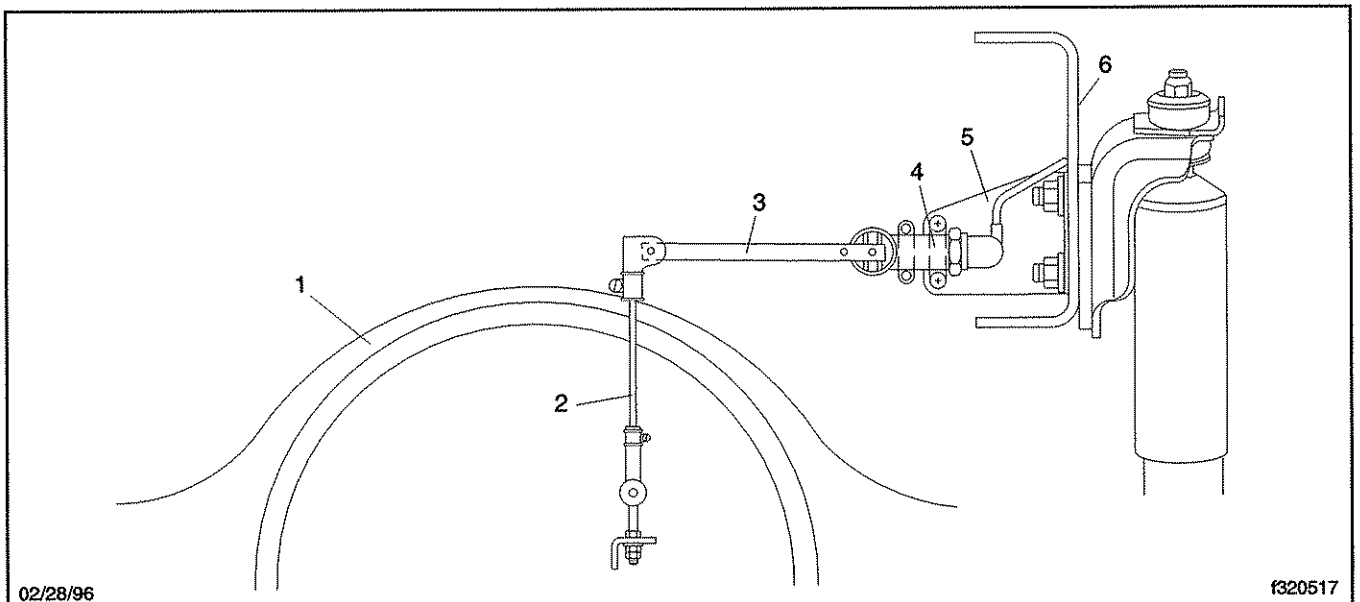
Fig. 1, Solenoid Valve Assembly

11. Connect the electrical connector to the valve.
12. Remove chocks from tires.

Height Sensor Replacement

Replacement

1. Shut down the engine and set the parking brake.
2. Chock the front tires.
3. At the ECAS height sensor (see **Fig. 1**), which is mounted between the frame rail and the drive axle housing, disconnect the electrical plug on the back of the sensor.
4. Remove the bolts attaching the sensor to the frame rail bracket.
5. Disconnect the linkage rod from the axle housing.
6. Remove the overtravel lever from the height sensor.
7. Remove the sensor.
8. To install the sensor, attach the overtravel lever to the height sensor.
9. Attach the linkage rod to the axle housing.
10. Fasten the sensor to the frame rail bracket.
11. Connect the electrical plug to the back of the height sensor.
12. Remove the chocks from the tires.



1. Axle
2. Linkage Rod
3. Overtravel Lever
4. Sensor
5. Bracket
6. Frame Rail

Fig. 1, Height Sensor Assembly

Troubleshooting Information

1. Indicator Lights:
   - ECAS FAIL lights up if there is a failure in the ECAS system.
   - Load XFER lights up whenever there is a manual or automatic load transfer.
2. Frame Height Control: ECAS will maintain the vehicle frame height to a preset value within 3/16-inch (4.7 mm) by adjusting the pressure in the rear suspension air bags. With the remote-control unit, the operator can adjust the frame height within the operating limits if the vehicle is parked or traveling less than 7 mph (15 km/h).
3. Load Transfer Activation: The weight is transferred from the tag axle to the drive axle by adjusting the pressure in the air bags. The load is shifted for 20 seconds, then is slowly equalized back to the normal condition. The complete load transfer cycle takes approximately 45 seconds. The load transfer occurs under the following conditions.
   - Automatic activation: The drive wheels slipping (usually when staring out on a slick surface) will activate the load transfer. If the vehicle is equipped with Automatic Traction Control, the load transfer will activate just after the ATC.
   - Manual activation: Pressing the MOM ON (Momentary On) side of the ECAS XFER dash switch will activate the load transfer. Manual activation works only at vehicle speeds less than 30 mph (50 km/h).
4. Load Transfer Termination: The load transfer cycle will terminate under the following conditions.
   - Applying the service brakes with a vehicle speed of more than 30 mph (50 km/h).
   - Vehicle speed exceeds 75 mph (120 km/h).
   - Pressing the STOP button on the remote control or disconnecting the remote control. This will terminate the load transfer at any speed.

Troubleshooting Tables

Before performing any diagnostics, make sure there are no ABS faults. Because of the interaction of the ABS and the ECAS systems, a fault in one system may cause a malfunction in the other system.

The following types of failures cause the "ECAS FAIL" indicator light to remain on:

- Grounded "ECAS FAIL" light wire;
- No power at ECAS electronic control unit (ECU) pin 1;
- Electrical fault in ECAS height sensor;
- Electrical fault in ECAS valve;
- Failure of J1587 data bus;
- Internal ECU fault;
- Faulty calibration of ECAS height control;
- Frame height cannot be adjusted within five minutes after ignition or within 30 seconds during normal service.

See **Table 1** for troubleshooting problems when the "ECAS FAIL" light remains on. This would include problems where the wrong action occurs, such as the air bags inflating rather than deflating, or the drive axle air bags deflating rather than the tag axle air bags. The causes may be crossed electrical wiring or air supply plumbing.

See **Table 2** for frame height problems.

See **Table 3** for incorrect ECAS functionality.

See **Table 4** for indicator lamp problems.

See **Table 5** for manual load transfer problems.

NOTE: All lamps are activated by the ECU for approximately two seconds after the ignition is switched on. The ignition must be switched off for at least 6.4 seconds before restarting to determine lamp condition.

Troubleshooting

Electrical Systems Testing

Electrical Systems Testing				
System Tested	**Ignition**	**Test these pins on ECAS ECU harness 35-pin connector (disconnected unless otherwise noted)**	**Acceptable Value**	**Remedy (if not within specification)**
ECAS FAIL light	On	—	Light is out	Find short to ground in wire between ECAS FAIL light and ECU.
Ground	Off	27 and Battery Ground	0 ohms	Trace wire between pin 27 and ground to find cause of high resistance.
Ground	Off	1 and 27	System voltage	Find open circuit or cause of high resistance in wiring.
Ignition and constant power	On	1 and 27 9 and 27	System voltage	Find open circuit or cause of high resistance in wiring.
Height sensor	Off	25 and 27	100 to 140 ohms	If resistance is infinite (open circuit), find open circuit in wires to height sensor and repair. If there is continuity but resistance is out of specification, check resistance at height sensor. If sensor is not within specification, replace sensor.
ECAS valve electrical checks	Off	13 and 27 15 and 27 30 and 27	15 to 25 ohms	If resistance is infinite (open circuit), find open circuit in wires to ECAS valve and repair. If there is continuity but resistance is out of specification, check resistance at ECAS valve. If valve is not within specification, replace valve.
Data bus connectivity (ECAS reads vehicle speed and other data from J1587 data bus)	On	Connect harness to ECU, and run Service Link to see if ECU is connected to data bus.	—	If other ECUs are identified with Service Link, check data bus wires to ECU for open, grounded, or crossed wires (pins 4 and 2). If no other ECUs are identified with Service Link, there is a main data bus problem, not a specific ECAS problem.
Internal ECU fault	—	There is no test for ECU. If all other tests are within specifications, ECU is probably bad.	—	Replace ECU.

Table 1, Electrical Systems Testing

Frame Height Systems Testing

Frame Height Systems Testing		
System Tested	**Test Procedure**	**Remedy (if not within specification)**
ECAS height calibration	Using the remote control unit, raise or lower the vehicle frame. Press the Normal key, and the frame should return to normal height.	Install the height sensor arm in the correct position relative to the height sensor rotating spool.
Frame height adjust time	Check air suspension system for leaks or restrictions in lines or valve ports. Check air supply system for proper charge time.	Repair as required.

Table 2, Frame Height Systems Testing

ECAS Functionality Testing

ECAS Functionality Testing				
System Tested	**Ignition**	**Test these pins on ECAS ECU harness 35-pin connector (disconnected)**	**Acceptable Value**	**Remedy (if not within specification)**
Inflate function	On	Connect 9 to 15. Alternately connect 13 to 9 and to 15.	All rear suspension air bags inflate when (and only when) 13 is connected	Make sure there is adequate air in the supply tanks to inflate the air bags. Check for crossed wiring to the ECAS valve. Check for correct air plumbing between the ECAS valve and the air bags. **⚠ CAUTION** Do not over-inflate air bags. This may extend the shock absorbers to their limits and cause damage.
Deflate function	On	Connect 9 to 13	All rear suspension air bags deflate	Make sure there is adequate air in the supply tanks to inflate the air bags. Check for crossed wiring to the ECAS valve. Check for correct air plumbing between the ECAS valve and the air bags.
Load transfer function	On	Connect 9 to 30	Tag axle air bags deflate	Make sure there is adequate air in the supply tanks to inflate the air bags. Check for crossed wiring to the ECAS valve. Check for correct air plumbing between the ECAS valve and the air bags.
		Disconnect 9 from 30 Connect 9 to 15	Pressure will equalize between drive and tag axle air bags.	Check for crossed wiring to the ECAS valve. Check for correct air plumbing between the ECAS valve and the air bags.

Table 3, ECAS Functionality Testing

Troubleshooting

Indicator Light Testing

Indicator Light Testing				
System Tested	**Ignition**	**Test these pins on ECU harness 35-pin connector (disconnected)**	**Acceptable Value**	**Remedy (if not within specification)**
ECAS FAIL light	On	Connect 33 and 27	Light on	Replace bulb. If bulb still does not light, check the wiring between the bulb and the 35-pin connector.
ECAS XFER light	On	Connect 18 and 27	Light on	Replace bulb. If bulb still does not light, check the wiring between the bulb and the 35-pin connector.

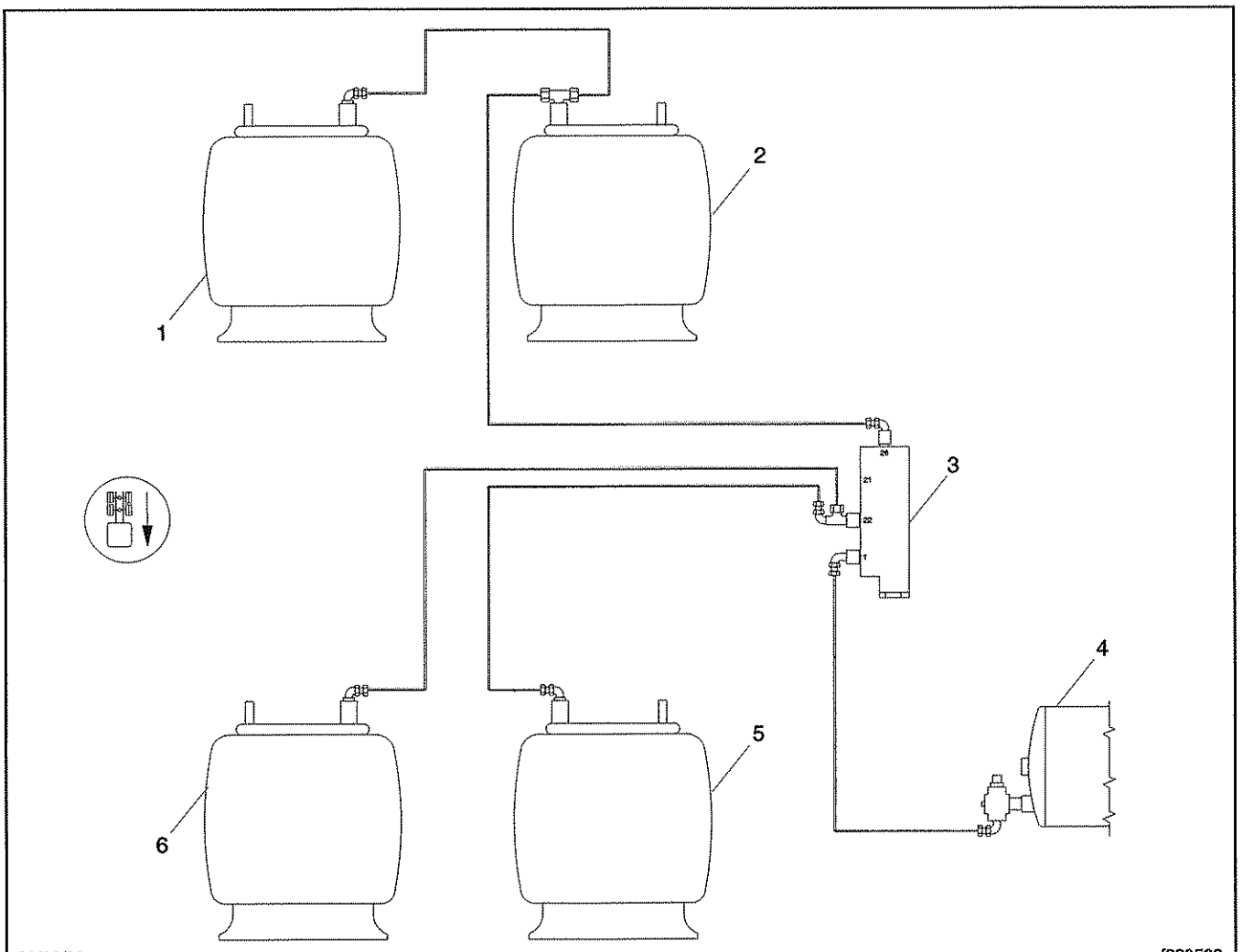
Table 4, Indicator Light Testing

Manual Load Transfer Testing

Manual Load Transfer Testing				
System Tested	**Ignition**	**Test These Pins On ECAS ECU harness 35-pin connector**	**Acceptable Value**	**Remedy (if not within specification)**
Manual load transfer switch	Off	17 and 27, MOM ON switch released (with harness disconnected)	>30k ohms	Locate and repair ground (wire pin to pin 17).
		17 and 27, MOM ON switch pressed (with harness disconnected)	0 to 2 ohms	Locate and repair high resistance in switch circuit.
	On	ECAS ECU harness; Jump pin 17 to ground (with harness connected to ECU	Load transfer cycle will occur	Perform air bag functionality tests. If air bags function correctly as described, manual load transfer function of ECU is malfunctioning. Replacement of ECU is probably necessary.

Table 5, Manual Load Transfer Testing

See **Fig. 1** for the AirLiner Plus air system plumbing diagram, and see **Fig. 2**, **Fig. 3** and **Fig. 4** for diagrams of the AirLiner Plus electrical system.



1. Right Rear Air Bag
2. Left Rear Air Bag
3. Solenoid Valve
4. Secondary Air Reservoir
5. Left Forward Air Bag
6. Right Forward Air Bag

Fig. 1, AirLiner Plus ECAS Air System Plumbing Diagram

Specifications

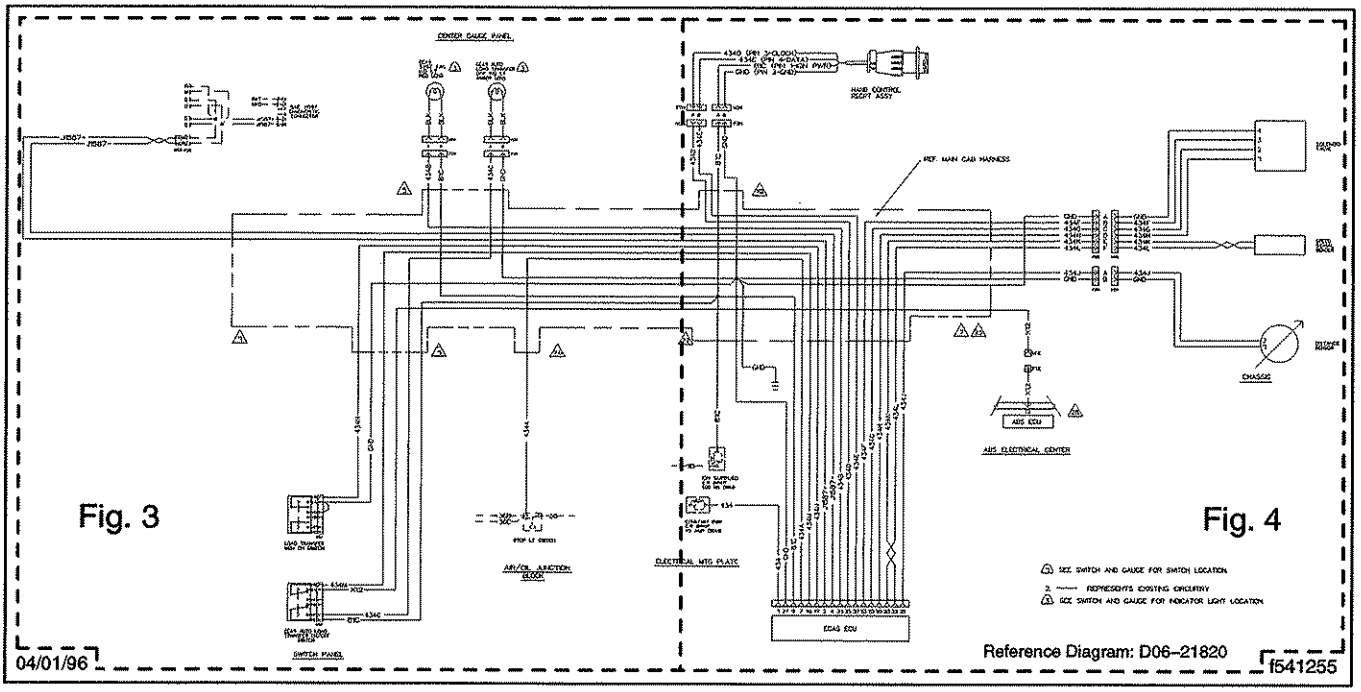


Fig. 2, AirLiner Plus ECAS Electrical Diagram (complete view)

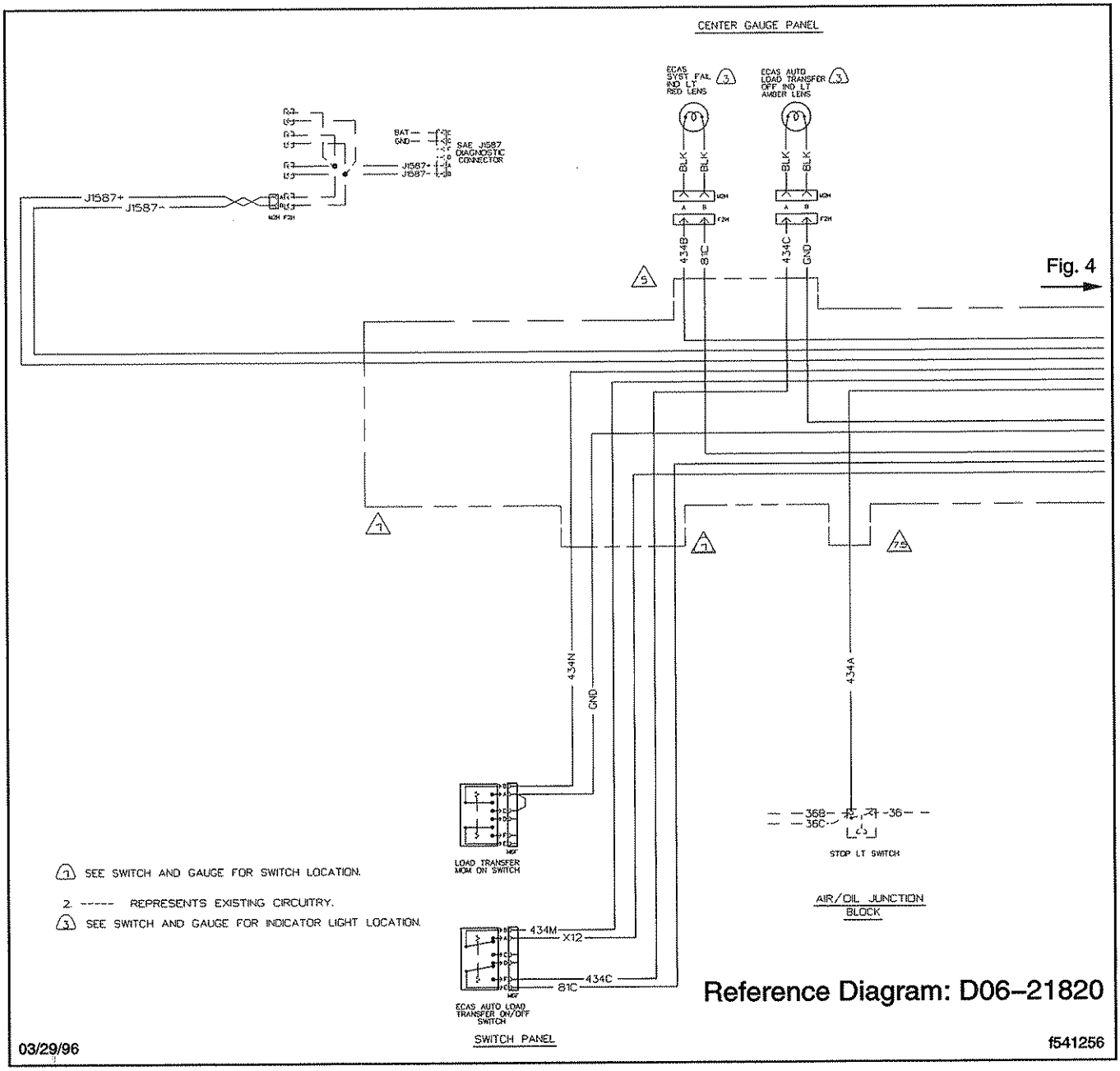


Fig. 3, AirLiner Plus ECAS Electrical Diagram (partial view)

Specifications

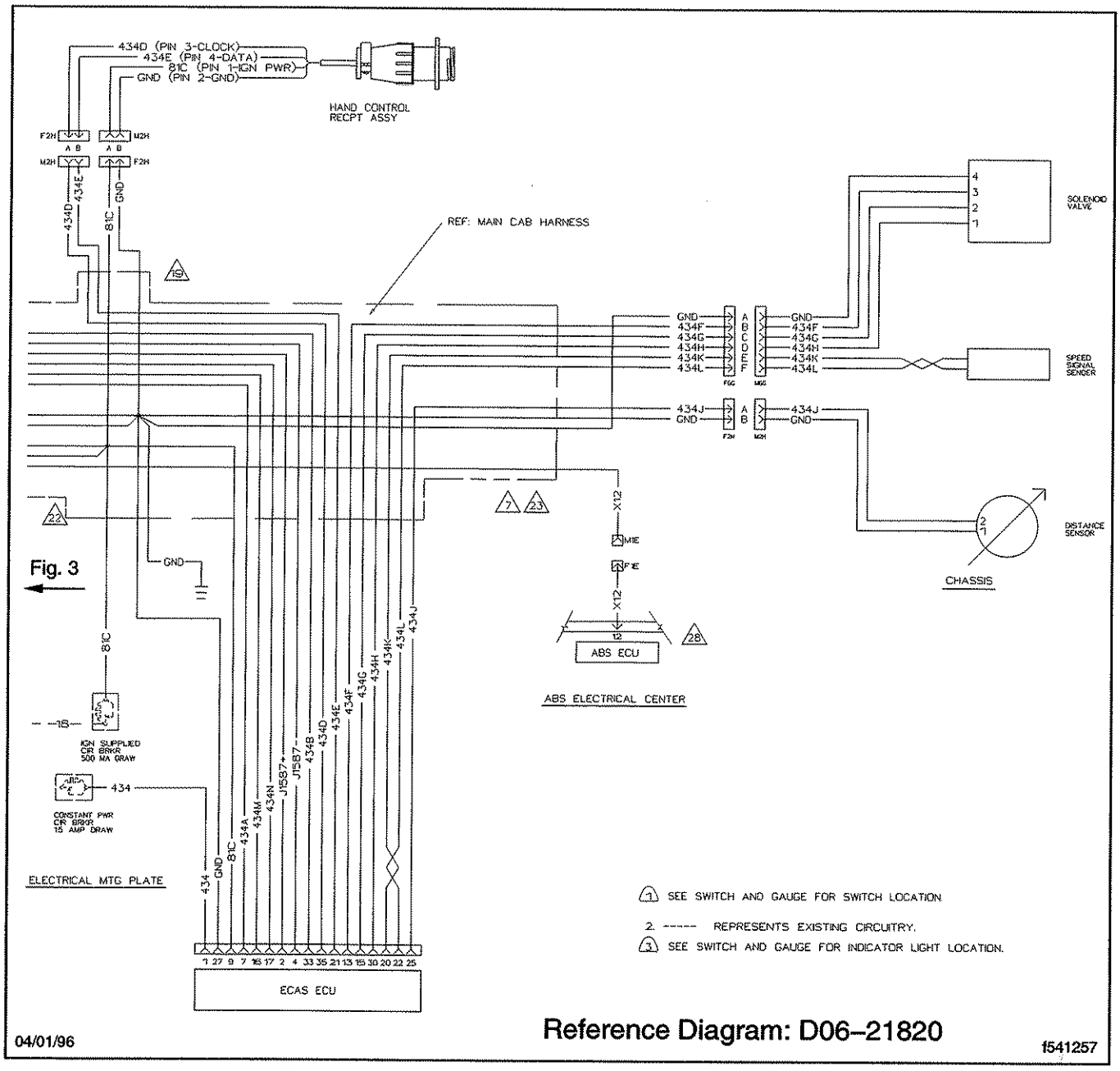


Fig. 4, AirLiner Plus ECAS Electrical Diagram (partial view)

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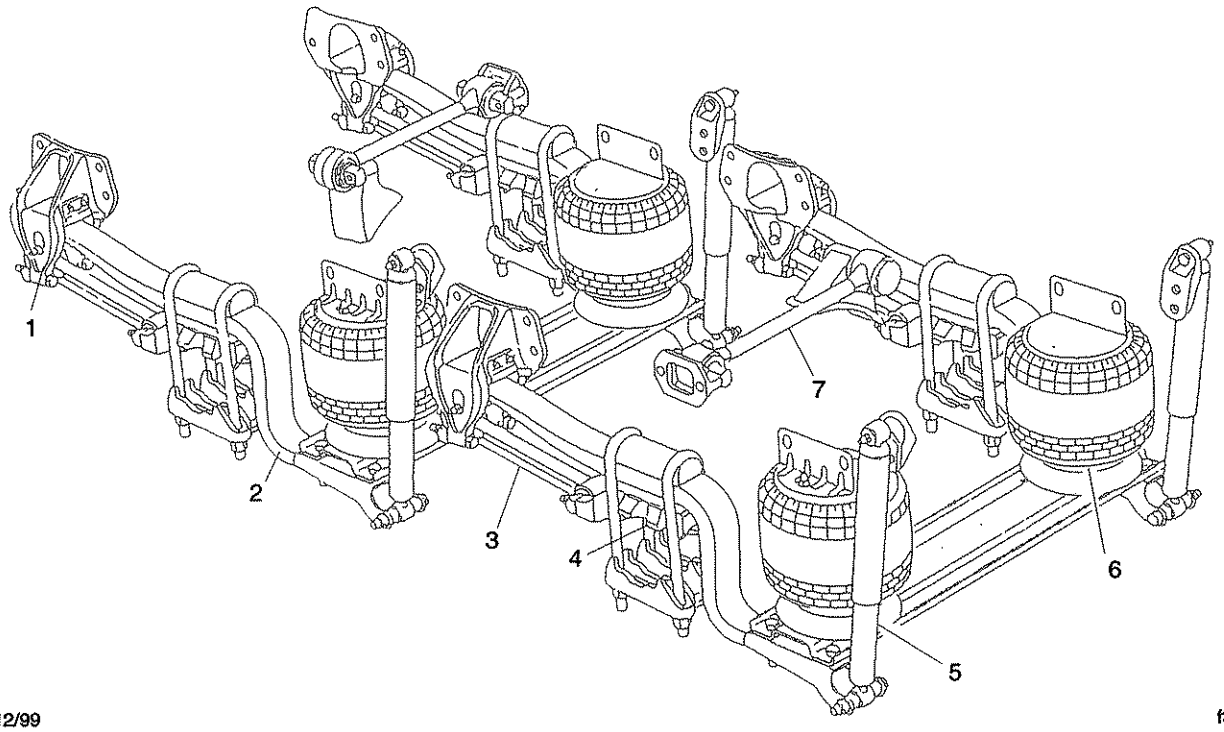
General Description

The Hendrickson HAS suspension (see **Fig. 1**) uses air bags to support the sprung weight on vehicles with both single and tandem axles. The air bags (air springs) mount on a crossmember between the two main support beams that are fastened to the axle housing and pivot on forward-mounted hanger brackets on the frame. Torque rods, running from the hanger brackets to the axle seats, transfer vehicle motion to the frame. Lateral stability is provided by transverse torque rods from the inside of the frame rails to brackets on the axle housings. The shock absorbers help to dampen the oscillations of the air springs and control the torque reaction of the axle housings on acceleration.

AIR CONTROL SYSTEM

The Hendrickson HAS air suspension system allows for a smooth ride while maintaining a constant ride height, even with varying loads. Although most vehicles with the HAS system use only one height control valve for the rear suspension, some vehicles with uneven loading may have a height control valve for each side of the vehicle. An optional suspension dump system permits the driver to temporarily lower the frame for trailer coupling or uncoupling without having to leave the cab. See **Subject 400** for a schematic of the air control system.

The suspension air control system uses air supplied from the secondary air brake system. The air supply line is connected to a secondary air manifold located behind the instrument panel. If a loss of air pressure occurs forward (upstream) of the protection valve, the air spring system will be isolated and maintain the air pressure within the suspension system until repairs can be made. However, if a loss of air occurs rearward (downstream) of the protection valve, the air in the brake system will be protected, but the air pressure in the air springs will be lost.



1. Hanger Bracket
2. Main Support Beam
3. Torque Rod
4. Axle Seat
5. Shock Absorber
6. Air Spring
7. Transverse Rod

Fig. 1, Rear Suspension, Hendrickson HAS-Series

General Information

The vehicle ride height is maintained by a height control valve mounted on the frame and linkage that connects the valve to the suspension crossmember. (See **Fig. 2**). As the frame-to-axle housing clearance changes due to a change in the vehicle load, the linkage moves the lever on the height control valve, causing air to move in or out of the air bags. A slight delay in the operation of the height control valve prevents the system from trying to adjust the ride height for each suspension movement.

The optional air suspension dump system is used to deflate the rear suspension air springs during trailer coupling and uncoupling operations. The dump control valve is located on the dash in the cab. When the dump control valve is toggled, supply air flows through the dump control valve delivery port and pressurizes the signal line to the relay valve. The pressurization of the signal line closes the relay valve supply port while opening the ports from the air bags to the atmosphere. Air from the air bags exhausts through the relay valve until the dump control valve is released or until the frame rests on the stops inside the air bags. A pressure switch in the signal line to the relay valve senses the signal pressure and switches on an optional red status light on the dash. To allow the air springs to inflate after being dumped, the dump control valve must be first toggled downward to exhaust the pressure in the signal line.

The pilot-operated relay valve is used for rapid deflation of the air bags for trailer coupling and uncoupling. When pilot pressure from the dump control valve is applied to the relay valve, the supply air from the height control valve is stopped from flowing through the relay valve and, simultaneously, the air spring pressure is exhausted directly to the atmosphere through passages in the relay valve.

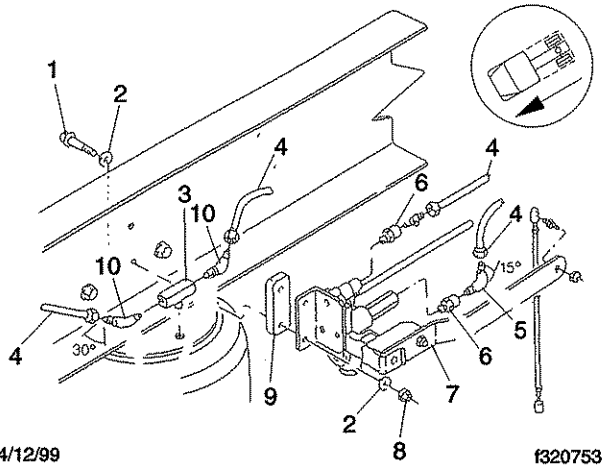
REAR SUSPENSION COMPONENTS

The axle housing, the lower shock mounts and the lower air bag mounts are all solidly attached to the HAS main support arms. See **Fig. 3and Fig. 4**. The main support arm hanger brackets, the upper shock mounts and the upper air bag mounts are all solidly mounted to the frame rails. The torque rods, with flexible bushings in each end, connect the hangers to the axle seats. When the vehicle travels over a bump, the axle housing suddenly rises and compresses the air bags. The pressure in the air bags increases immediately, which absorbs most of the energy of the upward-moving axle housing without transferring that movement to the frame. The shock absorbers then help absorb the release of that higher pressure by slowing the downward movement of the axle housing after the bump.

The front of each main support arm is allowed to pivot and slide on replaceable slipper pads in the hanger brackets. A torque rod is attached to each hanger bracket and to each axle seat bracket by rubber bushings with internal pins, installed in the torque rods at specified angles. Shims are used for adjustment at the front of each torque rod to make sure that the wheels run parallel to the frame rails.

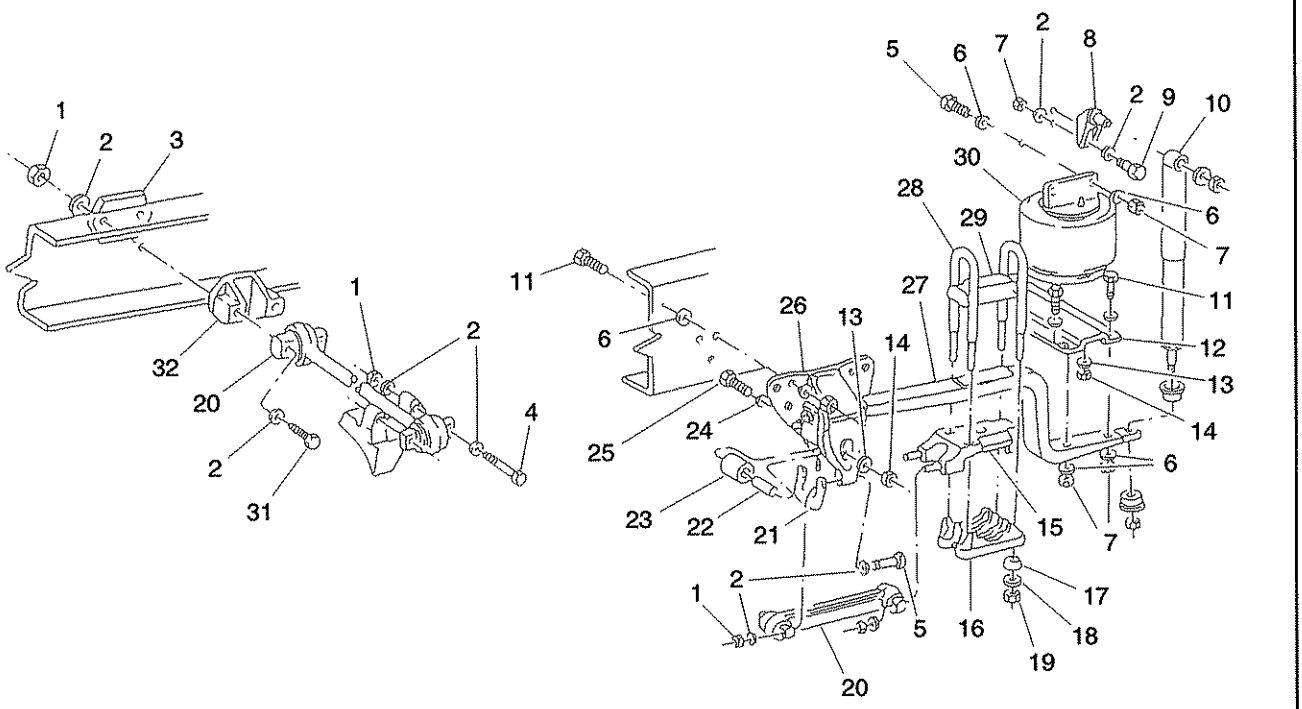
The torque rods control the forward and aft movement of the unsprung pieces during suspension travel. The flexible rubber bushings in the torque rods allow vertical movement of the axle housing while limiting its forward and aft movement. The driveline angles are kept within the specified limits by the torque rods' control of the rotational forces on the axle housings during acceleration and deceleration. The torque rods transfer the forward motion of the axle housing to the frame rails on acceleration and pull back on the frame during braking.

The transverse rods, also with rubber bushings in each end, connect the brackets on the axle housings to the brackets on the frame rails. The transverse rods keep a constant lateral relationship of the frame to the axle



1. Bolt
2. Washer
3. Tee
4. Tube Assembly
5. Elbow
6. Adapter
7. Height Control Valve
8. Nut
9. Bracket
10. Elbow

Fig. 2, Height Control Valve Assembly (typical)



1. Nut
2. Washer
3. Reinforcement
4. Bolt
5. Bolt
6. Washer
7. Nut
8. Shock Absorber Mounting Bracket
9. Bolt
10. Shock Absorber
11. Bolt
12. Suspension Support
13. Washer
14. Nut
15. Axle Seat
16. Bottom Cap Assembly
17. Spherical Washer
18. Washer
19. Nut
20. Transverse Rod Assembly
21. Alignment Shims
22. Spacer
23. Rebound Roller
24. Washer
25. Bolt
26. Hanger
27. Main Support Beam
28. U-Bolt
29. Top Pad
30. Air Spring Assembly
31. Bolt
32. Bracket

Fig. 3, Rear Suspension Components, Hendrickson HAS-40LH Series

housing, while still allowing vertical movement of the axle housings.

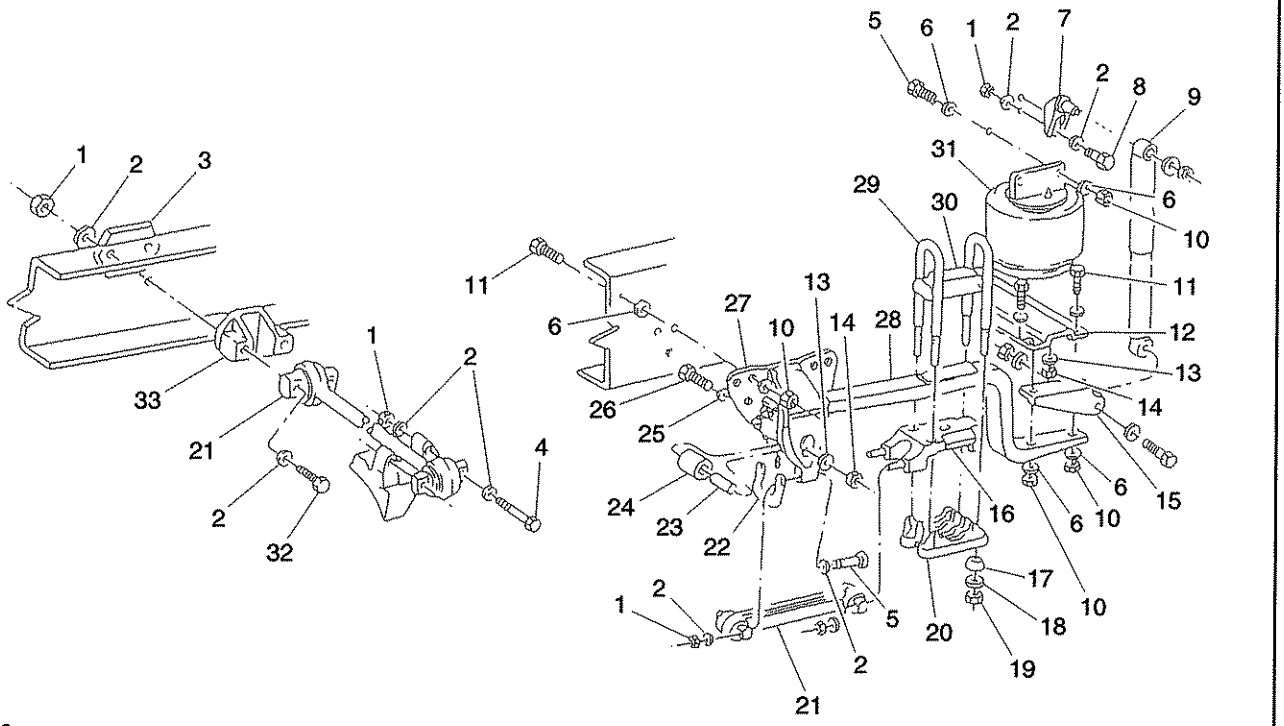
The Hendrickson HAS suspension is available in varying capacities and for limited off-highway use. The heavy-duty or off-highway suspensions have thicker main support arms, heavier crossmembers and torque rods, and heavy-duty air bags and shock absorbers. There are two HAS ride height specifications (measured from the bottom of the frame rail to the bottom of the main support arm at the axle seat) depending on which suspension is used. The HAS suspensions are available for single or tandem axle vehicles and can be ordered with or without the suspension dump feature.

REAR SUSPENSION SERVICE NOTES

⚠ WARNING

A main support member that has been subjected to heat, nicks or gouges can fail, causing loss of vehicle control and possible personal injury or property damage.

General Information



1. Nut
2. Washer
3. Reinforcement
4. Bolt
5. Bolt
6. Washer
7. Shock Absorber Mounting Bracket
8. Bolt
9. Shock Absorber
10. Nut
11. Bolt
12. Suspension Support
13. Washer
14. Nut
15. Shock Absorber Mounting Bracket
16. Axle Seat
17. Spherical Washer
18. Washer
19. Nut
20. Bottom Cap Assembly
21. Transverse Rod Assembly
22. Alignment Shims
23. Spacer
24. Rebound Roller
25. Washer
26. Bolt
27. Hanger
28. Main Support Beam
29. U-Bolt
30. Top Pad
31. Air Spring Assembly
32. Bolt
33. Bracket

Fig. 4, Rear Suspension Components, Hendrickson HAS-400, HAS-402, and HAS-460 Series

⚠ CAUTION

Do not use an arc welder on the suspension parts or use a cutting torch to remove any fasteners. The use of heat on suspension components will adversely affect the strength of these parts. Never reinstall used suspension fasteners. Always use the same part number or an exact equivalent part number when replacing any suspension fastener. All fasteners must be tightened to their specified torque and the U-bolts must be tightened in stages as described in Specifications 400.

Check the axle alignment after replacing components that affect alignment, such as a main support beam, a torque rod or a hanger.

NOTE: During installation, apply Pipe Sealant with Teflon D8AZ–19554–A or equivalent meeting specification WSK–M2G350–A2 or ESR–M18P7–A to the air fitting threads.

NOTE: When replacing the torque rod bushings, lubricate the new bushings with a vegetable-based oil only. Make sure the new bushings are centered in the torque rod bores.

NOTE: A shim pack of three 0.11 inch (2.8 mm) thick spacers are used to adjust axle lateral tracking offset. Install the spacers as required to adjust tracking.

Main Support Member Removal and Installation

Removal

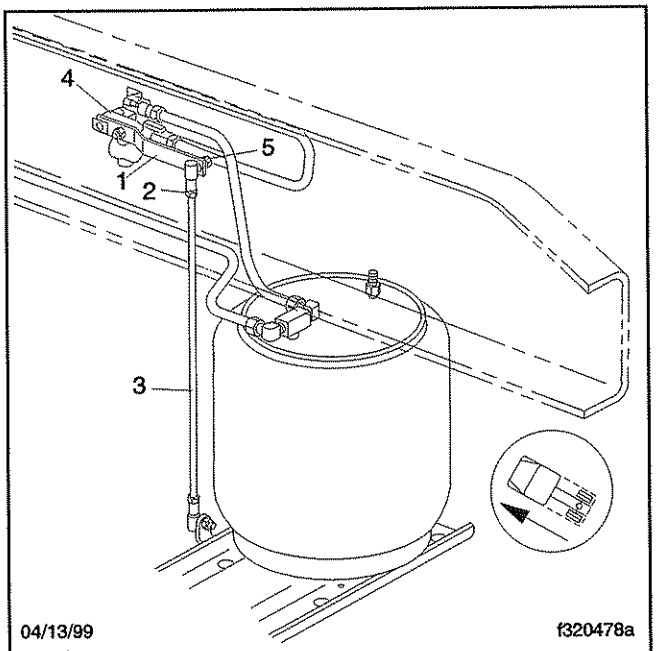
NOTE: Operation of the HAS suspension will result in wear between the main support member and the spring hanger slipper pad. In normal use, these components will function satisfactorily even though they show some wear. Premature wear may occur, however, and requires the replacement of one or both parts. A main support member should be replaced if it has 3/8 inch (9.5 mm) or more wear at the hanger cam contact area.

1. Stop the vehicle on a level surface, shut down the engine and apply the park brakes. Chock the front and rear tires.
2. Support the axle housing with a jack stand under the pinion nose to prevent the axle housing from rotating when the U-bolts are removed.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

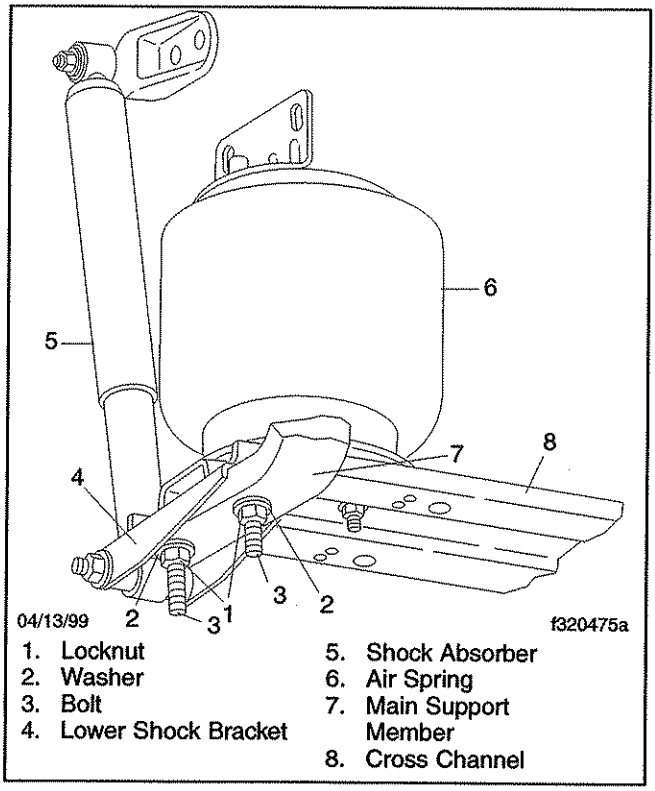
3. Disconnect the vertical linkage for the height control valve at the end of the horizontal lever. See **Fig. 1**. Lift the lever on the height control valve so that the air bags raise the frame about 3 inches (75 mm). Support the frame at that position with jack stands.
4. Remove the locknuts, washers and bolts that connect the cross channel and shock absorber brackets to both main support members. See **Fig. 2**. Remove the lower shock mount fasteners on the HAS–40LH models.
5. Use a floor jack to raise the cross channel about 3 inches (75 mm). Support the cross channel assembly with jack stands.
6. Remove the locknut, washers and bolt from the rebound roller assembly at the front hanger. See **Fig. 3**. Remove the rebound roller and spacer.
7. Remove the U-bolt high nuts and washers, then remove the bottom cap, U-bolts and the top pad and Delrin liner.
8. Slide the main support member out of the hanger and remove the main support assembly from the vehicle.
9. Inspect the main support member for wear. Replace the main support member if worn more than 3/8 inch (9.5 mm) at the hanger end where it contacts the slipper pad or if it has cracks, nicks or signs of the application of heat from a torch or welder.
10. Inspect the slipper pad for wear. Replace the slipper pad if worn. Remove the four bolts and washers that hold the slipper pad to the hanger. If rivets were installed instead of bolts to hold the slipper pad, use a grinder to remove the rivet heads.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Ride Height Control Linkage

Main Support Member Removal and Installation



1. Locknut
2. Washer
3. Bolt
4. Lower Shock Bracket
5. Shock Absorber
6. Air Spring
7. Main Support Member
8. Cross Channel

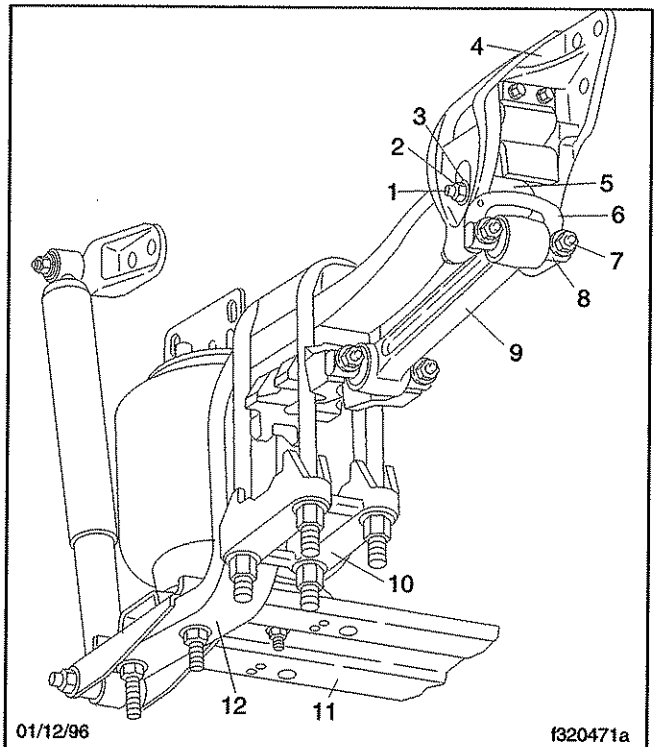
Fig. 2, Main Support Member

Installation

⚠ WARNING

Always use new fasteners when installing suspension components. Reuse of fasteners can lead to component damage and loss of vehicle control, possibly resulting in personal injury or property damage.

1. Install the slipper pad, bolts and washers into the hanger. Tighten the bolts 25 lbf·ft (34 N·m). Install new rivets if so equipped.
2. Slide the main support member into the hanger assembly.
3. Position the main support member on the axle seat, or on the spacer plate if the vehicle is so equipped, with the main support member center dowel sliding into the hole in the axle seat or spacer plate.
4. The Delrin liner must be positioned on the top of the main support member. Install the U-bolt top pad on the Delrin liner. Install the U-bolts over the top pad and liner and around the main support member, the spacer (if so equipped), the axle seat assembly, the axle housing, and the bottom cap. Install the washers and high nuts and tighten with your fingers, but do not fully tighten the U-bolt high nuts at this time.



1. Rebound Bolt
2. Locknut
3. Washer
4. Hanger
5. Rebound Roller
6. Alignment Shim(s)
7. Bolt
8. Bar Pin
9. Torque Rod
10. Bottom Cap
11. Cross Channel
12. Main Support Member

Fig. 3, Removing the Rebound Roller

5. Lower the floor jack under the cross channel until the cross channel is against the main support members. Install the shock absorber bracket (if so equipped) and bolts into the cross channel and main support members. See **Fig. 2**. Install the washers and tighten the locknuts 280 lbf·ft (380 N·m). On the HAS–40LH models, install the lower shock absorber mount bolts, washers and nuts. Tighten the shock absorber nut 60 lbf·ft (82 N·m).

6. Install the rebound roller into the hanger. Install the bolt, washer and locknut. Tighten the locknut 60 lbf·ft (82 N·m).
7. Center the main support member between the hanger legs. Move the lever for the height control valve up to lift the frame from its jack stands. Remove the jack stands from the frame.
8. Tighten the U-bolt locknuts in stages as described in **Specifications 400**. Rap the top of the U-bolts with a hammer and then retighten the high nuts 500 lbf·ft (680 N·m).

IMPORTANT: Do not exceed the specified torque on the U-bolt high nuts. Retighten the U-bolt high nuts after 1000 miles (1600 km).

9. Move the lever for the height control valve down to lower the frame until the upper ball joint stud in the vertical linkage exactly aligns with the hole in the lever when the lever is in the horizontal position. Install the height control valve ball joint stud, washer and locknut. Tighten the locknut 10 lbf·ft (14 N·m).
10. Remove the jack stand from under the nose of the axle housing.
11. Check and adjust the ride height as described in **Subject 180**.
12. Check the alignment after new main support members are installed.

Axle Seat Removal and Installation

Removal

1. Stop the vehicle on a level surface, shut down the engine and apply the park brakes. Chock the front and rear tires.
2. Support the axle housing with a jack stand under the pinion nose to prevent the axle housing from rotating when the U-bolts are removed.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

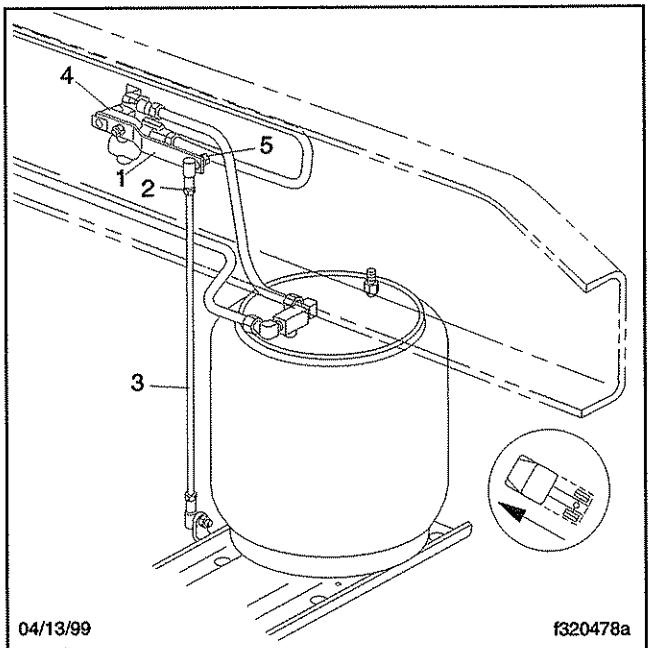
3. Disconnect the vertical linkage for the height control valve at the end of the horizontal lever. See **Fig. 1**. Lift the lever on the height control valve so that the air bags raise the rear of the frame about 3 inches (75 mm). Support the frame at that position with jack stands.
4. Remove the nuts, washers and bolts that hold the torque rod to the hanger legs.
5. Remove the nuts and washers that hold the torque rod to the axle seat. Remove the torque rod.
6. Remove the high nuts from the U-bolts and remove the bottom cap and top pad and Delrin liner.
7. Use a floor jack to raise the cross channel and main support member just enough to remove the axle seat.
8. Remove the axle seat. See **Fig. 2**.
9. If the axle seat studs need replacement, remove them with a hammer and brass drift.

Installation

⚠ WARNING

Always use new fasteners when installing suspension components. Reuse of fasteners can lead to component damage and loss of vehicle control, possibly resulting in personal injury or property damage.

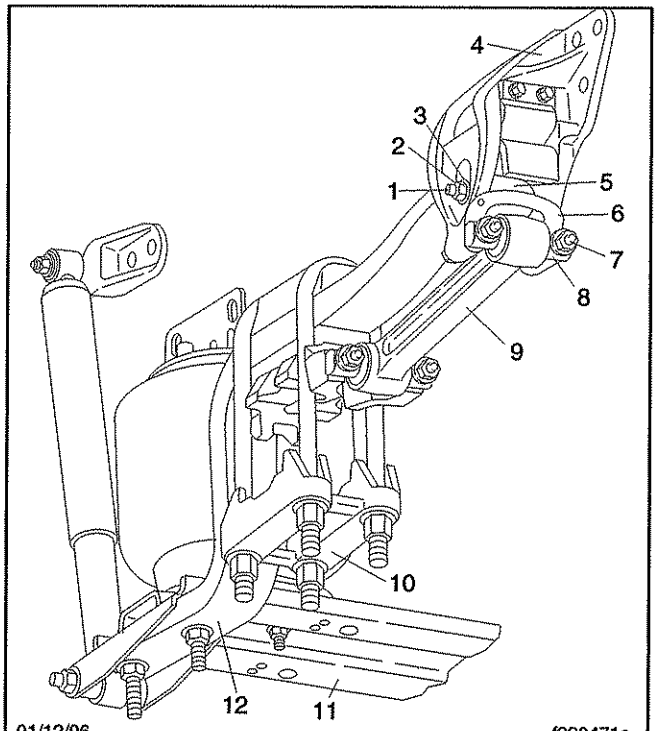
1. Install the new studs with a stud driver. Insert the stud in the hole of the axle seat and tap into position with a hammer and brass drift.
2. Lift the main support member with a floor jack and install the axle seat on the top of the axle housing. Install the spacer (if so equipped) above the axle seat.
3. Position the main support member on the axle seat, or on the spacer plate if the vehicle is so equipped, with the main support member center dowel sliding into the hole in the axle seat or spacer plate.
4. The Delrin liner must be positioned on the top of the main support member. Install the U-bolt top pad on the Delrin liner. Install the U-bolts over the top pad and liner and around the main support member, the spacer (if so equipped), the axle seat assembly, the axle housing, and the bottom cap. Install the washers and high nuts and tighten with your fingers, but do not fully tighten the U-bolt high nuts at this time.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Ride Height Control Linkage

Axle Seat Removal and Installation



1. Rebound Bolt
2. Locknut
3. Washer
4. Hanger
5. Rebound Roller
6. Alignment Shim(s)
7. Bolt
8. Bar Pin
9. Torque Rod
10. Bottom Cap
11. Cross Channel
12. Main Support Member

Fig. 2, Removing the Axle Seat

5. Install the torque rod on the axle seat so that the holes in the bushing pin align with the axle seat studs. Install the washers and nuts, but do not tighten at this time.
6. Install the front end of the torque rod onto the hanger legs and install any shims that were removed. Install the bolts through the hanger legs, shims, and the front bushing pin.
7. Tighten the nuts on the front of the torque rod 175 lbf·ft (237 N·m).
8. Tighten the nuts for the torque rod pin at the axle seat 175 lbf·ft (237 N·m).
9. Move the lever for the height control valve up to lift the frame from its jack stands, Remove the jack stands from the frame.
10. Tighten the U-bolt locknuts in stages as described in **Specifications 400**. Rap the top of the U-bolts with a hammer and then retighten the high nuts 500 lbf·ft (680 N·m).

IMPORTANT: Do not exceed the specified torque on the U-bolt high nuts. Retighten the U-bolt high nuts after 1000 miles (1600 km).

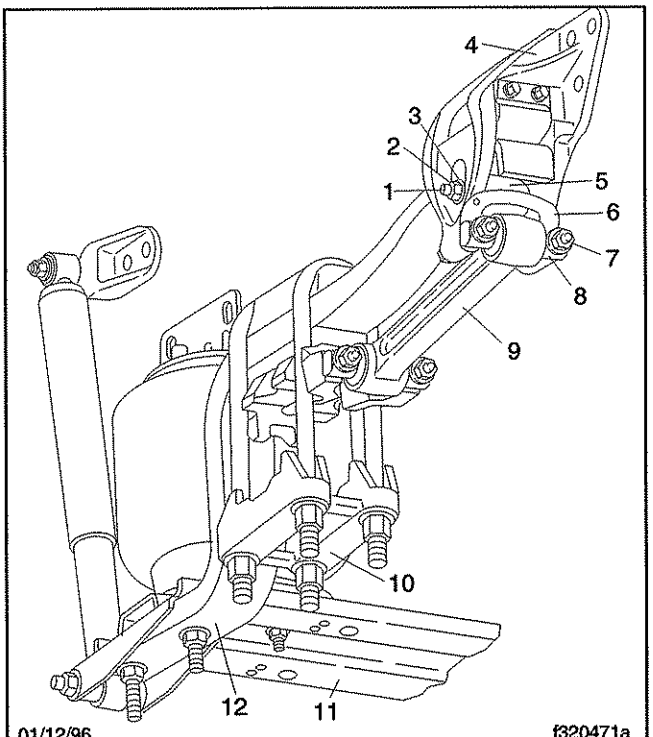
11. Move the lever for the height control valve down to lower the frame until the upper ball joint stud in the vertical linkage exactly aligns with the hole in the lever when the lever is in the horizontal position. Install the height control valve ball joint stud, washer and locknut. Tighten the locknut 10 lbf·ft (14 N·m).
12. Remove the jack stand from under the nose of the axle housing.
13. Check and adjust the ride height as described in **Subject 180**.
14. Check the alignment after new axle seats are installed.

Torque Rod Bushing Replacement

Replacement (See Fig. 1)

Use the following procedure to replace the torque rod bushing.

1. Chock the front tires, and the tires of the drive axles.
2. Remove the bushing pin locknuts and washers at the axle end of the torque rod. See **Fig. 1**.
3. Loosen the rebound bolt locknut in the hanger.
4. Remove the bushing pin locknuts, bolts and washers, and any alignment shims at the hanger end of the torque rod. Note the number of shims, as the same thickness shim pack must be reinstalled to avoid affecting the vehicle's alignment.



1. Rebound Bolt
2. Locknut
3. Washer
4. Hanger
5. Rebound Roller
6. Alignment Shim(s)
7. Bolt
8. Bar Pin
9. Torque Rod
10. Bottom Cap
11. Cross Channel
12. Main Support Member

Fig. 1, Torque Rod Installation

5. Push out the old bushings. Use a vertical shop press with a capacity of at least 10 tons. A 5-inch (127 mm) piece of 2-inch by 1/4-inch (50-mm by 6-mm) wall, steel-tubing receiving tool is required. The bushings are not cartridge-type bushings and do not have a metal outer sleeve.
6. Support the torque rod end on the receiving tool with the end tube of the torque rod centered on the tool.

⚠ WARNING

Do not use heat or a cutting torch to remove the bushings from the torque rod. The use of heat will weaken the torque rod, which could cause the rod to break. This could result in a loss of vehicle control, personal injury, or property damage.

7. Push directly on the bushing pin until the bushing is pushed out of the torque rod end tube.
8. Clean and inspect the torque rod ends. Remove any nicks with emery cloth.
9. Lubricate the torque rod ends and the new rubber bushings with a vegetable-based oil. Do not use a petroleum-based or soap-based lubricant.
10. Press in the new bushings while supporting the torque rod end on the receiving tool with the end tube of the torque rod centered on the receiving tool. The bushings must be installed with the mounting flats on the bar pin positioned 90 degrees to the shank of the torque rod. See **Fig. 2**.
11. Press directly on the bar pin of the bushings, which must be centered within the torque rod end tubes. When pressing in the new bushings, overshoot the final position by approximately 3/16 inch (5 mm).
12. Press the bushing again from the opposite side to center the bushing within the torque rod end.
13. Position the torque rod into the axle seat and attach it with the washers and locknuts. Handtighten the locknuts.
14. Position the torque rod onto the forward face of the hanger legs. Assemble the bolts, washers and locknuts, and any alignment shims. Tighten locknut 175 lbf·ft (237 N·m). See **Fig. 1**.
15. Tighten locknuts at the axle end of the torque rods 175 lbf·ft (237 N·m).

Torque Rod Bushing Replacement

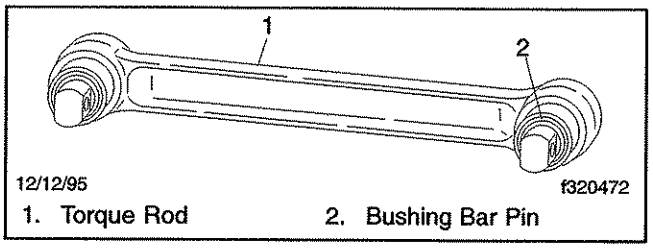


Fig. 2, Positioning the Bar Pin Mounting Flats

16. Tighten rebound bolt locknut 60 lbf·ft (81 N·m).

Height Control Valve Removal and Installation

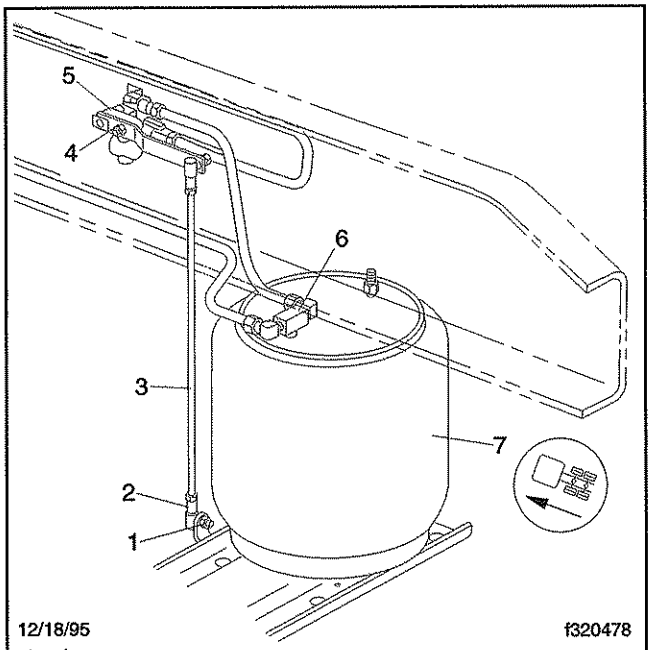
Removal

1. Chock the front tires.
2. Drain the vehicle's air system.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

3. Remove the height control valve vertical rod from the valve lever by removing the nut and lock washer. Push down on the lever of the height control valve to exhaust the air from the rear suspension air bags.
4. Remove the air lines attached to the height control valve. See **Fig. 1**.
5. Remove the locknuts, washers, and bolts that attach the height control valve to the frame.
6. Remove the brass air fittings from the height control valve.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Height Control Valve System

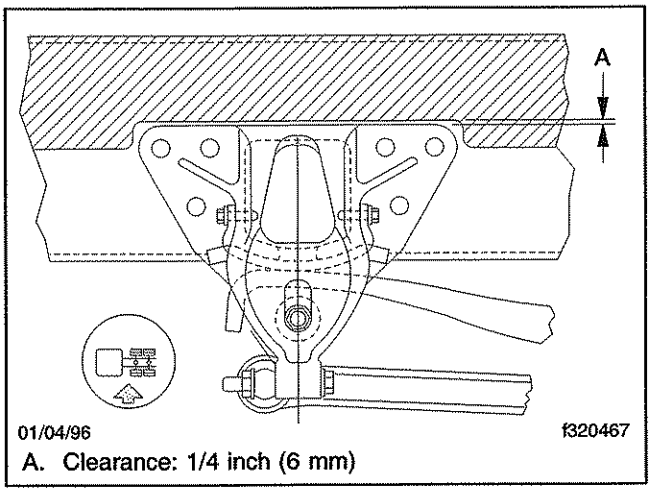
Installation

1. Install the brass air fittings into the height control valve ports.
2. Install the bolts, washers, and locknuts that attach the valve to the frame rail.
3. Attach the air lines to the height control valve.
4. Attach the height control valve vertical linkage rod to the height control valve lever, and install the lock washer and nut. See **Fig. 1**.
5. Return air to the system.
6. Adjust the height control valve for proper ride height as described in **Subject 180**.

Fifth Wheel/Hanger Clearance

Information

The HAS front hangers must have at least 1/4-inch (6 mm) clearance between the top of the hanger and the bottom of the fifth wheel mounting bracket on the sides of the frame rails. In some cases, the fifth wheel mounting bracket may have to be cut out to provide the correct clearance. See **Fig. 1** for an example of a fifth wheel mounting bracket that has been modified.



A. Clearance: 1/4 inch (6 mm)

Fig. 1, Fifth Wheel Mounting Angle Clearance

Quick Release Valve Replacement

Replacement (See Fig. 1)

1. Chock the front tires.
2. Drain the vehicle's air system.
3. Disconnect the air lines from the quick release valve. Identify the air line at the top of the valve.
4. Remove the quick release valve from the frame or cross member.
5. Remove the brass air fittings from the valve.
6. Attach the brass air fittings to the replacement quick release valve.
7. Attach the valve to the frame or cross member.
8. Connect the air lines to the valve, making sure to attach the identified line to the top of the valve.
9. Build up pressure in the air system.
10. Remove the chocks from the front tires.

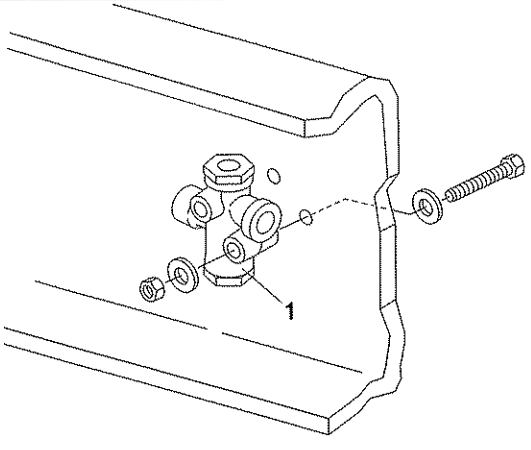


Fig. 1, Quick Release Valve Installation

Slipper Pad Removal and Installation

Removal

NOTE: Operation of the HAS suspension will result in wear between the main support member and the hanger slipper pad. In normal use, these components will function satisfactorily even though the components indicate some wear.

1. Chock the front tires.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

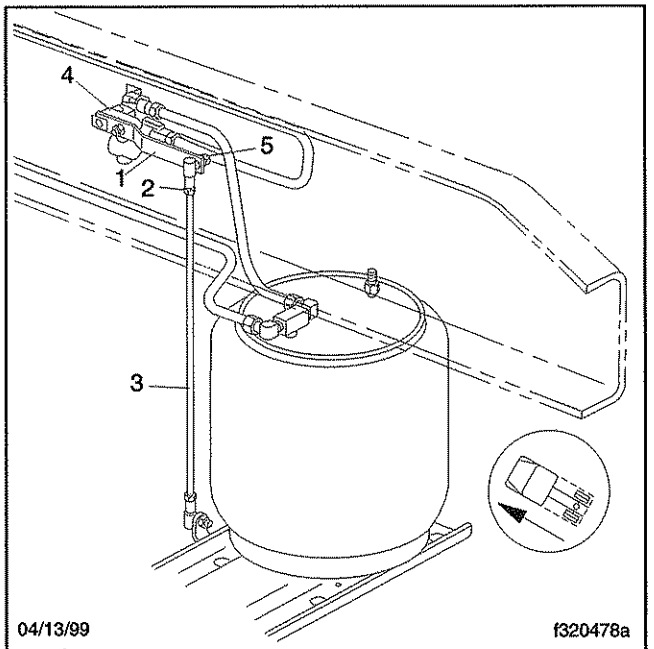
2. Disconnect the vertical linkage from the lever of the height control valve and lift the lever to raise the rear of the frame about 3 inches (75 mm). See **Fig. 1**.
3. Support the frame with jack stands.
4. Apply an upward force on the cross channel with a jack or, on single axles, by pushing down on the height control lever to lift the cross channel. This will cause the tips of the main support members to drop away from the slipper pad. See **Fig. 2**.

IMPORTANT: Do not nick or gouge the cross channel.

5. Remove the fasteners and the slipper pad. In some instances, the screws may have to be drilled out. See **Fig. 3**.
6. In some instances, remove the rebound roller to gain enough clearance to remove the slipper pad. Loosen the rebound bolt locknut, remove the washer, the bolt, and the rebound roller assembly.
7. For rivets, remove the four 1/4-inch (6-mm) rivets by grinding away the rivet heads. With a drift pin, punch the rivets through the holes and remove the slipper pad.

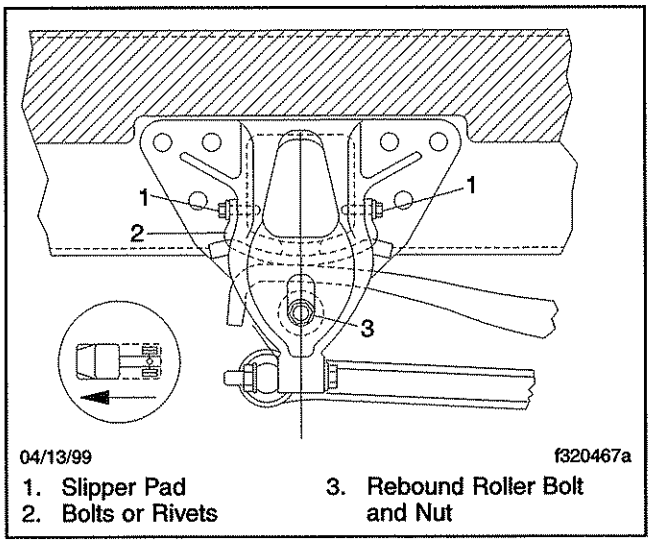
Installation

1. Position the slipper pad and retainer plate on the frame hanger.
2. Tighten the hexhead self-tapping screws 25 lbf·ft (34 N·m).



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Ride Height Control Linkage



1. Slipper Pad
2. Bolts or Rivets
3. Rebound Roller Bolt and Nut

Fig. 2, Slipper Pad Installation

Slipper Pad Removal and Installation

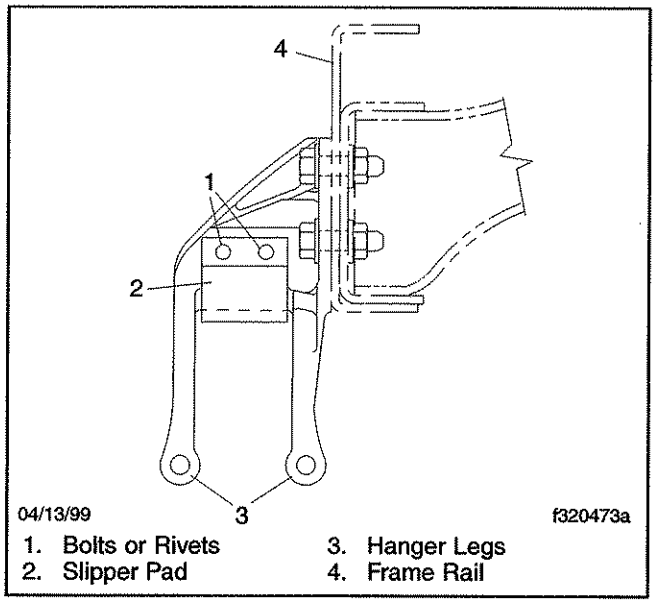


Fig. 3, Hanger Assembly

3. Or, install the rivets using a rivet gun.
4. Raise the frame off the jack stands by pulling up on the height control valve lever. Remove the jack stands.
5. Push down on the height control valve lever to lower the frame until the upper ball stud on the vertical linkage rod exactly aligns with the hole in the lever when the lever is horizontal.
6. Install the ball stud into the hole in the lever and install the washer and nut. Tighten the nut 10 lbf·ft (14 N·m).
7. Remove the chocks from the tires.

Cross Channel Removal and Installation

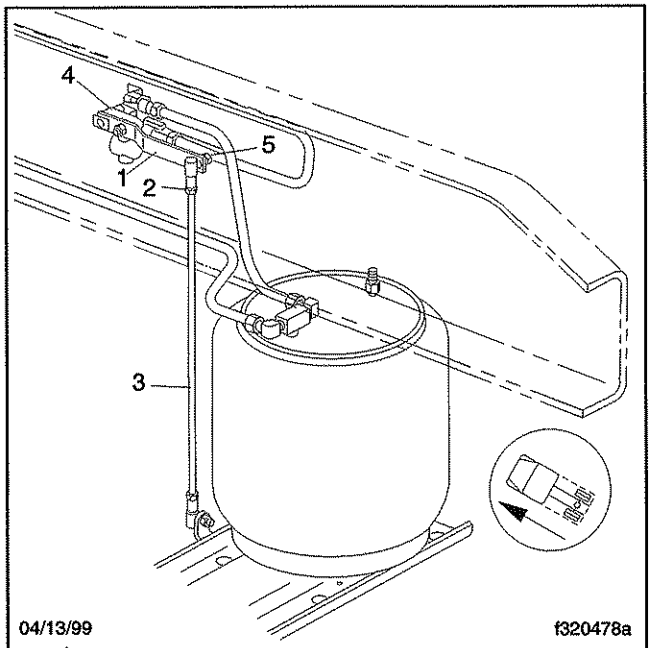
Removal

1. Stop the vehicle on a level surface and shutdown the engine. Chock the front and rear tires.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

2. Disconnect the vertical linkage for the height control valve at the end of the horizontal lever. See **Fig. 1**. Lift the lever on the height control valve so that the air bags raise the rear of the frame about 3 inches (75 mm). Support the frame at that position with jack stands.
3. Remove the locknuts and washers that attach both the air springs to the cross channel. See **Fig. 2**.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

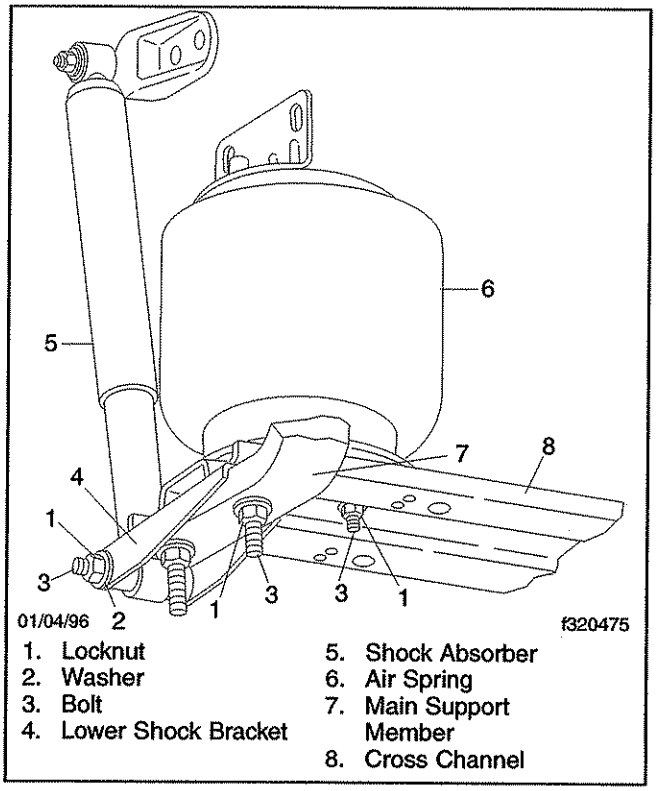
Fig. 1, Height Control Linkage

4. Remove the locknuts, washers, and bolts that attach the cross channel to the main support members and to the shock absorber lower mounting brackets.
5. Raise the cross channel by pushing down on the height control lever to compress the air springs just enough to clear the studs on the bottom of the air springs. Remove the cross channel.

Installation

1. Position the cross channel so that the holes in the cross channel are aligned under the studs of the air springs. Install the washers and nuts. Tighten the nuts on the air spring studs 25 lbf·ft (34 N·m).
2. Lower the cross channel assembly onto the main support members by pushing down on the height control valve lever.
3. Install the bolts, washers and locknuts that connect the cross channel to the main support member and lower shock absorber mounts. Tighten the locknuts 290 lbf·ft (393 N·m).
4. Raise the frame by lifting the height control valve lever and remove the jack stands.
5. Attach the ball joint stud of the vertical linkage rod to the height control valve link, and tighten the locknut on the ball joint stud 10 lbf·ft (14 N·m).
6. Remove the chocks from the tires.

Cross Channel Removal and Installation



1. Locknut
2. Washer
3. Bolt
4. Lower Shock Bracket
5. Shock Absorber
6. Air Spring
7. Main Support Member
8. Cross Channel

Fig. 2, Main Support Member

Axle Alignment Checking and Adjustment

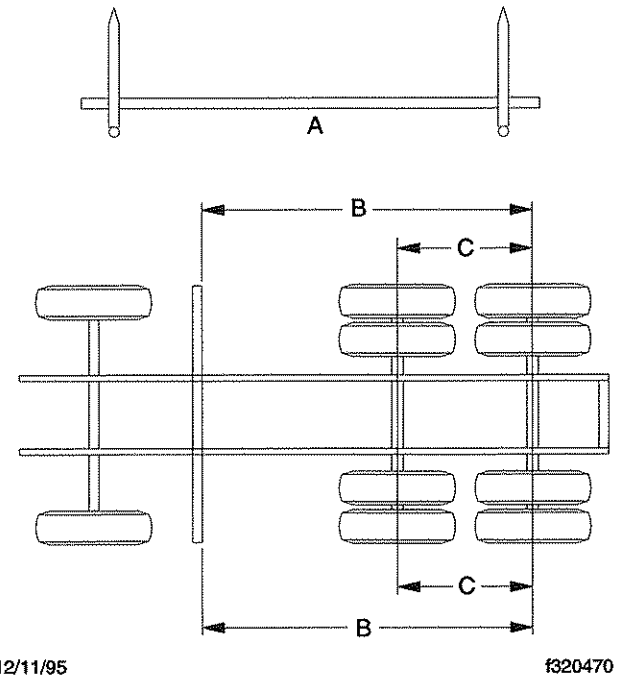
Checking and Adjustment

Use the following procedure after all repairs to the suspension:

1. Park vehicle on a level surface. Free and center all suspension joints by slowly moving the vehicle back and forth several times without applying the brakes.
2. Chock the front tires and the tires of drive axles.
3. C-clamp a nine-foot (2.74-m) piece of straight bar stock or angle iron across the frame. Select a location as far forward of the forward drive axle as possible where components will not interfere. The lower frame flange may be preferred on some vehicles, otherwise use the upper frame flange.
4. Align the straight bar stock or angle iron on the frame using a carpenter's square.
5. Check the rear drive axle first. See **Fig. 1**. Use a trammel bar or its equivalent to measure from the straight edge to the center line of the rear axle on both sides of the vehicle. If both sides measure within 3/16 inch (5 mm) of being the same, the alignment of the rear drive axle is acceptable. If the sides differ by more than 3/16-inch (5 mm), first loosen the rebound locknut, and then adjust the rear drive axle by loosening up the torque rod bar pin locknuts on the hangers. Add or remove drop-in shims as needed.

NOTE: The torque rod bar pin must be mounted to the forward face of the hanger legs. No more than four shims may be used (for a maximum thickness of 1/4 inch (6 mm).

6. Snug the torque rod bar pin locknuts but do not torque to specification.
7. With the rear drive axle properly aligned, the front drive axle alignment can be checked by measuring forward from the center of the axle shafts on the rear drive axle using a trammel bar. If the forward drive axle spacing measurements differ by more than 1/8 inch (3 mm), add or subtract shims at the forward hangers.
8. Following the adjustment of both axles, move the vehicle back and forth several times prior to removing the straight edge from the frame. Recheck the alignment.
9. Tighten the torque rod bar pin locknuts 180 lbf·ft (244 N·m).
10. Remove the chocks from the tires.



A. Trammel Bar
B. Each side must be within 3/16 inch (5 mm) of each other.
C. Distances between axles must be within 1/8 inch (3 mm) of each other.

Fig. 1, Drive Axle Tracking Alignment

Air Spring Replacement

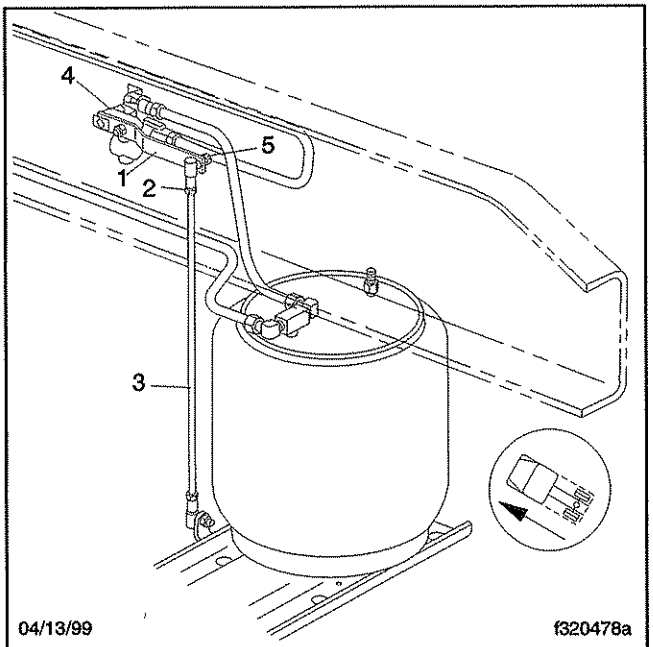
Replacement

1. Chock the front tires.
2. Support the frame with jack stands.
3. Drain the vehicle's air system.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

4. Remove the upper ball joint nut and stud from the lever on the height control valve. See **Fig. 1**. Move the height control valve lever down to exhaust all the air from the air bags.
5. Remove the locknuts and washers that attach the air spring to the cross channel. See **Fig. 2**.

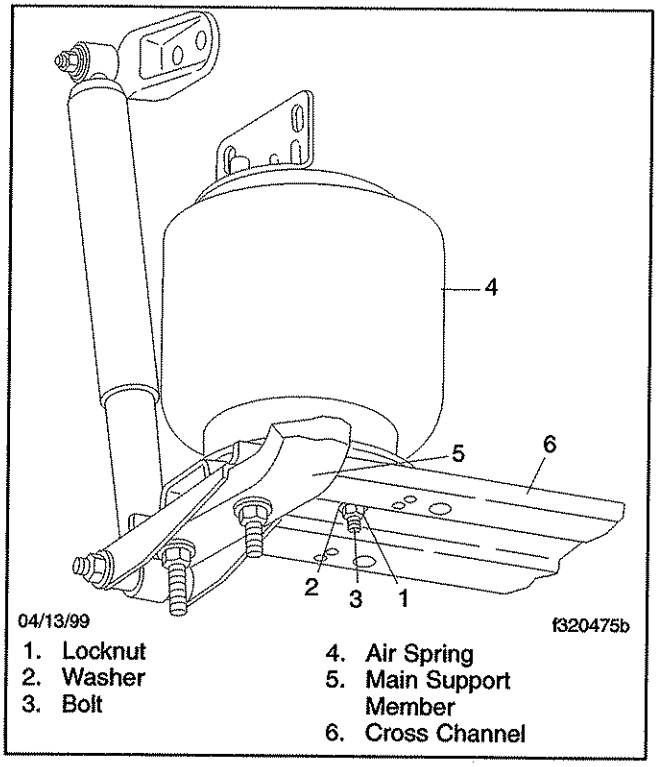


1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Ride Height Control Linkage

6. Disconnect the air lines to the air spring.
7. Remove the brass air fittings from the air spring.
8. Remove the locknuts and washers that attach the air spring to the upper air spring frame hanger.
9. Remove the air spring.
10. Attach the new air spring to the air spring frame hanger by inserting the studs into the appropriate holes.
11. Attach the air spring to the cross channel. Tighten the nuts 25 lbf·ft (34 N·m).
12. Tighten the outboard locknut that attaches the air spring to the air spring frame hanger 25 lbf·ft (34 N·m).
13. Attach the brass fittings to the air spring using a Teflon thread seal.
14. Connect the air lines to the air spring.
15. Connect the ball stud on the vertical linkage rod to the lever for the height control valve. Install the washer and tighten the nut 10 lbf·ft (14 N·m).
16. Remove the jack stands.
17. Build up pressure in the air system and check the ride height as described in **Subject 180**.
18. Remove the chocks from the tires.

Air Spring Replacement



1. Locknut
2. Washer
3. Bolt
4. Air Spring
5. Main Support Member
6. Cross Channel

Fig. 2, Air Spring Mounting

Air Spring Frame Hanger Removal and Installation

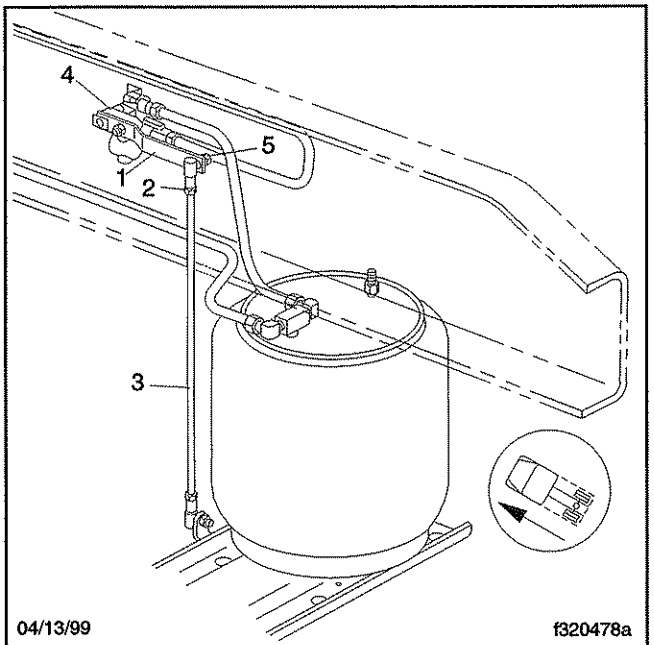
Removal

1. Chock the front tires.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

2. Disconnect the vertical linkage for the height control valve at the end of the horizontal lever. See **Fig. 1**. Lift the lever on the height control valve so that the air bags raise the rear of the frame about 3 inches (75 mm). Support the frame at that position with jack stands.
3. Drain the air from the vehicle's air system then lower the lever on the height control valve to exhaust the air from the air springs.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Height Control Valve Linkage

4. Disconnect the air lines from the air spring fittings.
5. Remove the brass air fittings from the air spring.
6. Remove the locknuts and washers that attach the air springs studs to the upper bracket on the frame rail. See **Fig. 2.**
7. Remove the nuts, washers and bolts that hold the upper air spring bracket to the frame rail. Remove the air spring bracket.

Installation

1. Position the air spring upper bracket on the frame rails. Install the bolts through the frame rail and upper bracket and install the washers, and locknuts. Tighten the locknuts 340 lbf·ft (461 N·m).
2. Attach the air spring to the air spring frame bracket. Tighten the outboard locknut 25 lbf·ft (34 N·m).
3. Attach the brass air fittings to the air spring port using Teflon thread sealant.
4. Connect the air lines to the air spring fittings.
5. Build up pressure in the air system and raise the height control lever to lift the frame off the jack stands. Remove the jack stands and lower the vehicle.
6. Align the ball joint stud in the vertical linkage rod with the hole in the height control lever. Install the ball joint stud, the washer and locknut. Tighten the locknut 10 lbf·ft (14 N·m).
7. Remove the chocks from the tires.

Air Spring Frame Hanger Removal and Installation

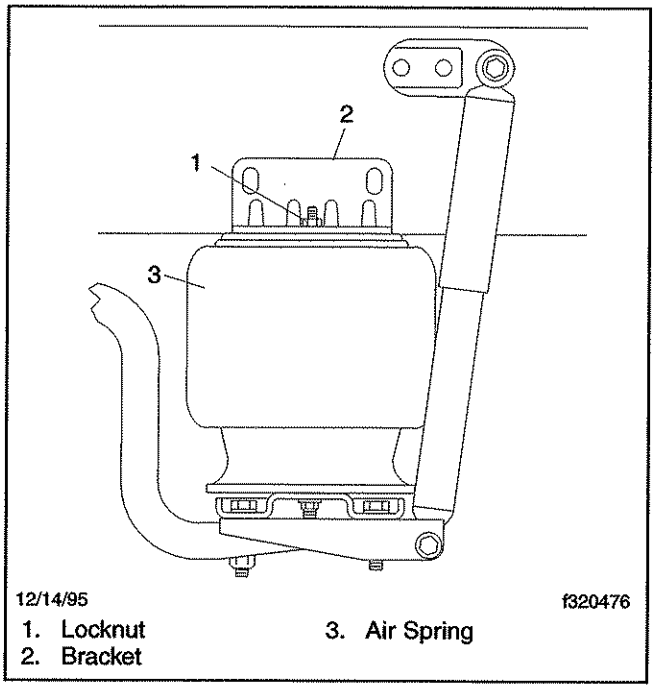


Fig. 2, Air Spring Installation

Shock Absorber Bracket Removal and Installation

Removal

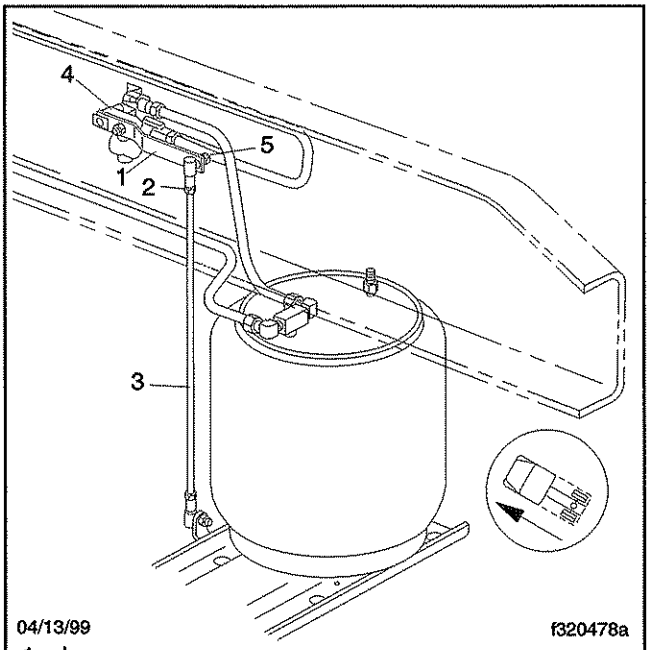
1. Chock the front tires.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

2. Remove the locknut and washer and disconnect the ball joint stud on the top of the vertical linkage rod from the height control valve lever. See **Fig. 1**.
3. Lift the height control lever to raise the rear of the frame enough to remove the load from the suspension.

   NOTE: The front of the main support member will move downward as the load is removed. Support the frame in this position with jack stands.



1. Lever
2. Ball Joint and Jam Nut
3. Vertical Linkage Rod
4. Height Control Valve
5. Locknut

Fig. 1, Height Control Valve Linkage

4. Remove the shock absorber. Refer to **Subject 170**.
5. Remove nuts, washers and bolts from the shock absorber frame hanger bracket. See **Fig. 2**. Remove the top shock absorber bracket from the frame.
6. Remove the nuts, washers and bolts that attach the cross channel and lower shock absorber bracket to the rear of the main support member.
7. Remove the lower bracket by sliding the bracket to the rear.

Installation

1. Install the bolts and washers that attach the frame hanger bracket from the inboard side of the frame. Install the brackets, washers and locknuts. Tighten the nuts 340 lbf·ft (461 N·m).
2. Position the lower bracket between the cross channel and the main support member.
3. Install the bolts and washers from the top of the cross channel, through the shock bracket and main support member. Install the washers and locknuts and tighten the locknuts attaching the cross channel to the main support member 290 lbf·ft (393 N·m).
4. Install the shock absorber. Install the washers at both sides of each shock bushing for a total of four washers per shock absorber.
5. Tighten shock absorber locknuts 60 lbf·ft (81 N·m).
6. Lift the lever of the height control valve to raise the rear of the frame off the jack stands. Remove the jack stands and lower the frame by pushing down on the height control valve lever.
7. Align the ball joint stud in the vertical linkage rod with the hole in the height control valve lever. Install the washer and locknut. Tighten the locknut 10 lbf·ft (14 N·m).
8. Remove the chocks from the tires.

Shock Absorber Bracket Removal and Installation

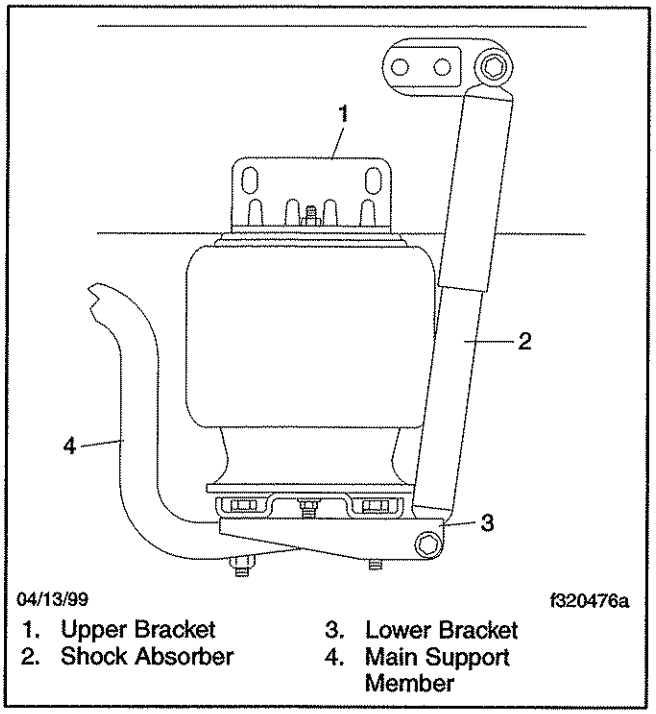


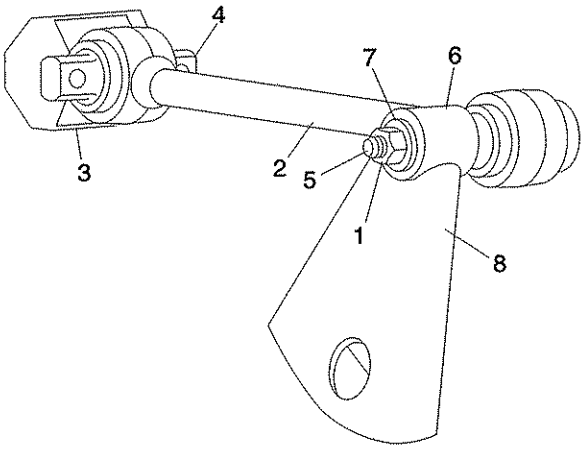
Fig. 2, Shock Absorber Mounts (typical)

Transverse Rod Removal and Installation

Removal (See Fig. 1)

NOTE: This procedure is for replacement of a transverse rod with a tapered stud at the axle connection and a straddle mount pin at the frame bracket end. Some installations have straddle mounts at both ends of the transverse rod.

1. Chock the front and rear tires.
2. Remove the nuts and washers from the bolts that fasten the pin in the transverse rod bushing to the frame bracket. Disconnect the transverse rod where it is attached to the frame bracket bracket.
3. Remove the nut from the tapered stud in the tube bracket on the axle housing. Hit the top of the axle bracket tube hard with a large hammer to momentarily distort the tube and loosen the tapered stud. Remove the stud and transverse rod from the bracket on the axle housing.



1. Locknut
2. Transverse Rod
3. Frame Bracket
4. Straddle Mount Pin
5. Tapered Stud End
6. Axle Bracket Tube
7. Washer
8. Axle Bracket

Fig. 1, Transverse Rod Assembly

Installation

1. Clear the tapered hole in the axle bracket of all foreign matter.
2. Insert the tapered stud and torque rod bushing into the bracket.
3. Attach the washer and locknut to the stud. Tighten 200 lbf·ft (271 N·m).
4. After tightening, hit the top of the axle bracket tube with a hammer to seat the tapered stud. Retighten.
5. Position the straddle mount end of the transverse rod at the frame bracket, and tighten 200 lbf·ft (271 N·m).
6. Remove the chocks from the tires.

Replacement

NOTE: Shock absorbers are 1 3/8 inches (35 mm) in diameter with a compressed length of 18 1/3 inches (466 mm) and an extended length of 30 inches (762 mm).

1. Chock the front tires.
2. Remove the nut, washer and bolts that attach the shock absorber to the frame hanger bracket. See **Fig.1**.
3. Remove the fasteners that attach the shock absorber to the lower bracket.
4. Remove the shock absorber.
5. Install the new shock absorber with the rod and shield tube at the top. Install the bolts, washers and nuts in the lower bracket and the frame hanger bracket. Install washers at both sides of each shock bushing, that is four washers per shock absorber.
6. Tighten the fasteners 60 lbf·ft (81 N·m).

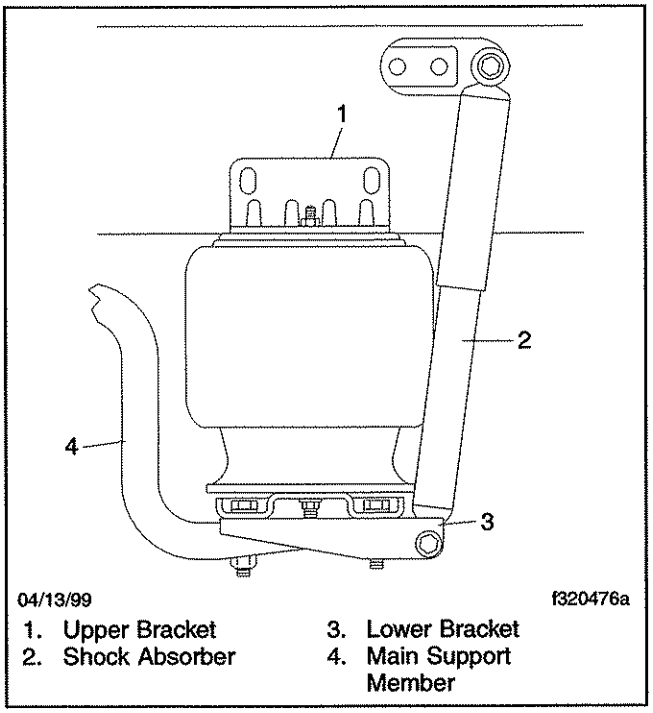


Fig. 1, Shock Absorber Mounts (typical)

General Information

NOTE: This subject applies only to Hendrickson series HAS 190/210/230/40LH/400/402/460 suspensions.

Adjust the vehicle ride height with the unloaded vehicle on a level surface. The frame slope, driveline angles, and axle mounting alignment should be checked after the ride height has been changed.

⚠ CAUTION

Failure to adjust the vehicle ride height could adversely affect driveline angles. Also, if the air springs are set too high, the driver may have difficulty (or be prevented from) backing the vehicle under a trailer. If the air springs are set too low, rapid wear of driveline parts will result.

Ride Height Adjustment

The vehicle ride height for Hendrickson HAS air suspension systems is changed by adjusting the length of the vertical linkage at the ride height control valve. Use the following procedure to adjust the ride height of the frame rails.

IMPORTANT: Before checking the ride height, make sure there is no load on the chassis. For tractors, unhitch the trailer. Trucks must be empty when checking the ride height.

1. Stop the vehicle on a level surface, using a light application of the brakes. Slowly move the vehicle forward and back several times without using the brakes to center the suspension joints. Do not apply the parking brakes.
2. Put the transmission in neutral. Build the secondary air pressure to at least 100 psi (690 kPa). Shut down the engine.

   NOTE: Allow several minutes for the air pressure to equalize in the system before checking the ride height.
3. Mark the location of the front and rear tires on the floor so that the vehicle can be checked in the same location after a test drive. Chock the front tires.

IMPORTANT: Any difference in height between the two sides of the vehicle must be corrected using spacers between the main support arm and the rear axle housing before setting the vehicle ride height. See the appropriate section in Group 32 in the vehicle's service manual for the alignment procedure.

4. Measure the distance from the bottom of the frame rail to the bottom of the main support arm at the rear axle U-bolts. See **Fig. 1**. The correct measurement for Hendrickson HAS suspension systems is 4-1/4±1/8 inches (108±3 mm) for vehicles with a specified ride height of 8-1/2 inches (215 mm) or greater. For vehicles with less than an 8-1/2-inch (215 mm) ride height, the distance between the bottom of the frame rail and the bottom of the main support arm must be 2-3/8 inches (60 mm).

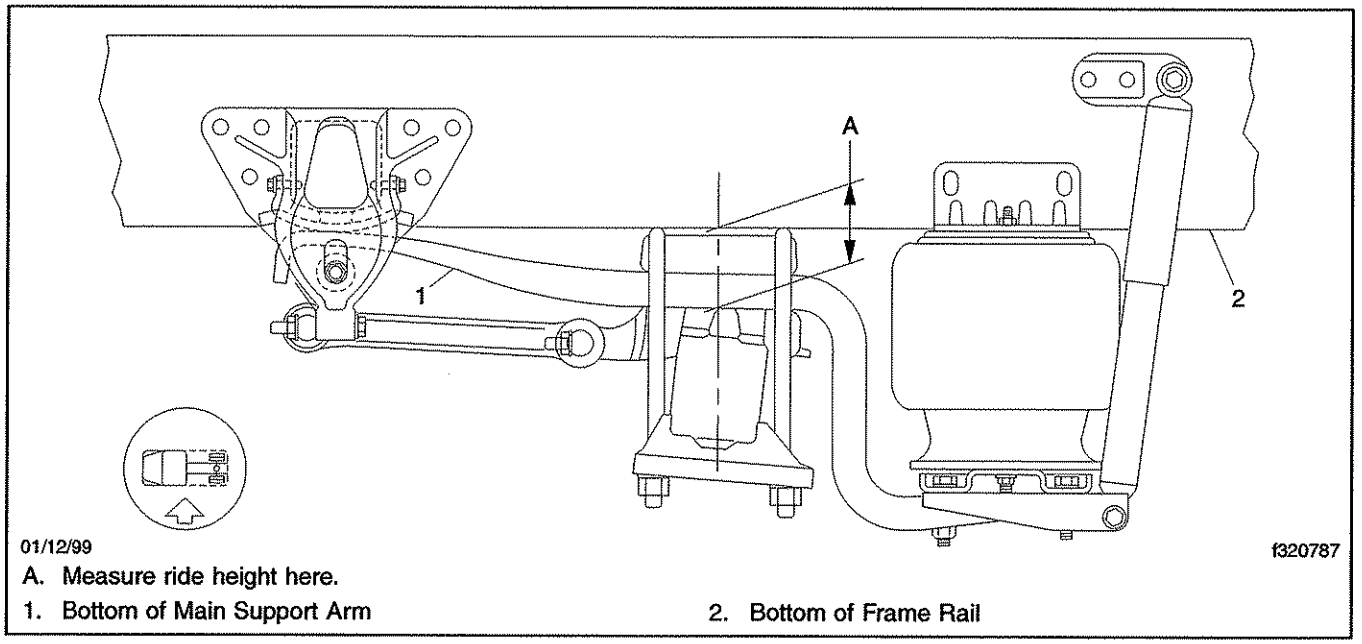
   If the measurement is the same as the specification at each support arm, the ride height is correctly adjusted. If the distance measured is not the same at each rear axle mount on the vehicle, correct this alignment problem before attempting to adjust the ride height.

⚠ WARNING

The air suspension system will start moving the frame when the lever for the ride height control valve is moved from its center position. To avoid injury or property damage, make sure that your hands and all objects are away from any pinch points when the lever is moved.

5. Remove the nut and lockwasher from the ball joint stud at the end of the lever on the ride height control valve. See **Fig. 2**. Separate the vertical rod assembly from the lever, being careful to avoid moving the lever while disconnecting the ball joint.
6. Push the lever down to lower the frame by removing the air in the suspension air bags.
7. Slowly pull the lever up to raise the frame until the ride height measurement is exactly correct for the specified ride height.
8. Make sure that the centering hole in the lever near its pivot aligns with the centering hole in the height control valve body. Check the height control valve to make sure that no air flows through the ride height control valve when the lever is in the centered position.
9. Loosen the jam nuts a few turns at the top and bottom ball joints on the vertical rod that attaches

Ride Height Adjustment

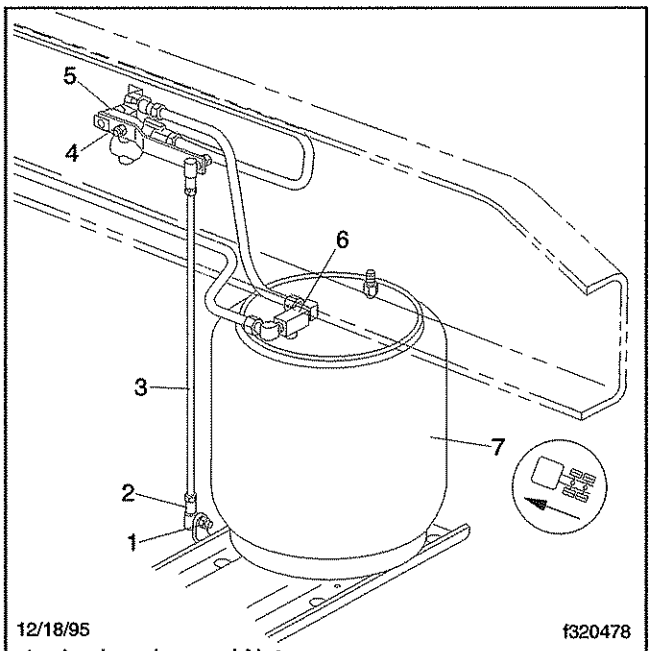


A. Measure ride height here.
1. Bottom of Main Support Arm
2. Bottom of Frame Rail

Fig. 1, Measuring the Ride Height

to the height control lever. Note that one of the ball joints and jam nuts has left-hand threads. Hold the top ball joint with your hand and turn the vertical rod with a wrench until the top ball joint stud exactly aligns with the hole in the end of the lever when the lever is centered horizontally on the control valve.

10. Install the ball joint stud in the lever and install the lockwasher and nut on the stud. Tighten the nut on the stud to 125 lbf·inch (11 N·cm).
11. Tighten the jam nut on each ball joint without changing the length of the vertical rod.
12. Apply the parking brakes; then remove the chocks from the tires. Drive the vehicle unloaded for about 1/4 mile (1/2 km); then stop the vehicle in the exact location (as previously marked) of the original measurement.
13. Park the vehicle using only a light brake application. Chock the tires on one axle only and put the transmission in neutral. Do not apply the parking brakes.
14. Check the adjusted distance between the bottom of the frame and the bottom of the main support arm at the U-bolts. See **Fig. 1.**
15. If the distance is still not correct, loosen the ball joint jam nuts on the vertical rod and turn the rod to adjust the ride height. Lengthen the vertical rod to raise the frame or shorten the rod to lower the frame to the correct ride height. Drive the vehicle and again check the ride height.
16. Apply the parking brakes; then remove the chocks from the tires.



1. Lockwasher and Nut
2. Ball Joint and Jam Nut
3. Vertical Rod
4. Leveling Arm Locknut
5. Ride Height Control Valve
6. Brass Air Fitting
7. Air Spring

Fig. 2, Ride Height Control System

Problem—All Air Bags Are Deflated

Problem—All Air Bags Are Deflated	
Possible Cause	**Remedy**
The vehicle air system pressure is too low.	Run the engine until the air gauge indicates 100 psi (690 kPa).
Air is leaking from the vehicle air system.	Listen for air leakage at the air fittings, tanks, and brake componenets. Repair or replace fittings as needed.
The linkage for the height control valve is disconnected or maladjusted.	Connect the linkage and adjust as described in **Subject 180.**
The suspension dump valve is activated.	Toggle the dump control valve to the normal position.
The relay valve is stuck open.	Check and repair the relay valve.
The air bags have a leak.	Listen for leaks at the air bags, tubes, and fittings.
The height control valve is not operating correctly.	Disconnect the linkage and raise and lower the lever to check the operation of the height control valve. Make sure that no air flows through the valve when the lever is in the center position. Replace the valve if it is bad.
There is a obstruction in the lines to the height control valve.	Check the air pressure at the height control valve supply port. Remove any obstruction or restriction to air flow to the valve.
The pressure protection valve is not allowing air to flow to the height control valve.	Check the operation of the pressure protection valve between the secondary air tank and the height control valve. Replace the valve if it is not operating correctly.

Problem—One Side of the Vehicle Is Higher Than the Other

Problem—One Side of the Vehicle Is Higher Than the Other	
Possible Cause	**Remedy**
The axle seat spacer thickness is not the same on each side.	Adjust the spacers so that the frame is level before adjusting the ride height.
The load on the vehicle is not distributed evenly.	Change the position of the load to ensure equal weight on each side.
There is an obstruction to air flow to the air bags on one side of the vehicle.	Disconnect the fittings and test the flow to the air bags on the lower side of the vehicle.
The height control valve or relay valve has an internal restriction.	Check for the same pressure at the ports on each side of the valve. Replace the valve if the pressure is not the same.
The air bags or fittings have a leak.	Listen for leaks at the air bags, tubes, and fittings. Tighten the fittings, if loose, or replace any bad parts.

Problem—The Ride Height Is Not Constant

Problem—The Ride Height Is Not Constant	
Possible Cause	**Remedy**
Air is leaking from the air bags or lines.	Listen or use soap bubbles to find air leaks. Tighten or replace leaking fittings or air bags.
The height control valve is not working correctly.	Make sure that no air is exhausted from the height control valve when the lever is in the horizontal position and that the air bags inflate when the lever is raised. The bags must deflate when the lever is pushed down. There must be a slight delay between the lever movement and the valve operation. Check for fluid leaks from the height control valve. Replace the valve if damaged.

Troubleshooting

Problem—The Ride Height Is Not Constant	
Possible Cause	**Remedy**
There is an obstruction to air flow to the air bags.	Disconnect the fittings and test the flow to the air bags.
The height control valve has a restriction at the exhaust port.	Check for air exhausting from the valve when the height control lever is pushed down.
The height control linkage is loose.	Make sure that all the jam nuts are tight and that the ball sockets are not worn.

Problem—The Ride Height Measurement Is Not Correct

Problem—The Ride Height Measurement Is Not Correct	
Possible Cause	**Remedy**
The vehicle is loaded.	The ride height of a loaded vehicle will be slightly lower than that of an unloaded vehicle. Adjust the ride only when the vehicle is unloaded.
The ride height adjustment is not correct.	Adjust the ride height as described in **Subject 180.**
Air is leaking from the air bags or lines.	Listen or use soap bubbles to find air leaks. Tighten or replace leaking fittings or air bags.
The height control valve is not working correctly.	Make sure that no air is exhausted from the height control valve when the lever is in the horizontal position and that the air bags inflate when the lever is raised. The bags must deflate when the lever is pushed down. There must be a slight delay between the lever movement and the valve operation. Check for fluid leaks from the height control valve. Replace the valve if damaged.
There is an obstruction to air flow to the air bags.	Disconnect the fittings and test the flow to the air bags.
The height control valve has a restriction at the exhaust port.	Check for air exhausting from the valve when the height control lever is pushed down.
The height control linkage is loose.	Make sure that all the jam nuts are tight and that the ball sockets are not worn.

Problem—The Air Springs Have Cuts

Problem—The Air Springs Have Cuts	
Possible Cause	**Remedy**
The ride height is adjusted too high.	Adjust the ride height so that the air bags are not continually overinflated.
The tires are too wide and are rubbing the air bags.	Install the correct tires.
A shock absorber or mount is broken.	Replace any broken components.

Problem—The Vehicle Does Not Track Straight

Problem—The Vehicle Does Not Track Straight	
Possible Cause	**Remedy**
The axle alignment is not correct.	Adjust the alignment with shims at the front of the torque rods.
The bushings in the torque rods are worn.	Replace the worn bushings.
The bushings in the transverse rods are worn.	Replace the worn bushings.
A shock absorber or mount is broken.	Replace any broken components.

Problem—The Vehicle Does Not Track Straight	
Possible Cause	**Remedy**
The U-bolt high nuts are loose.	Periodically tighten the nuts as described in **Specifications 400.**
The suspension fasteners are loose or damaged.	Tighten or replace the fasteners.

Problem—The Vehicle Vibrates When Driven

Problem—The Vehicle Vibrates When Driven	
Possible Cause	**Remedy**
The ride height is not correct.	Adjust the ride height as described in **Subject 180.**
The axle housing rotational alignment is not correct.	Adjust the rotational alignment of the axle housing with wedge-shaped shims at the axle seats. The driveline U-joint angles must be with 1% of each other.
The shock absorbers are worn or disconnected.	Replace the shock absorbers, if worn, or tighten the mounting fasteners.
The bushings in the torque rods are worn.	Replace the worn bushings.
The U-bolt high nuts are loose.	Periodically tighten the nuts as described in **Specifications 400.**
The suspension fasteners are loose or damaged.	Tighten or replace the fasteners.
The frame is not level from front to rear.	Check and adjust the ride height at the front suspension and each rear axle. The frame should not slope more than 1/2 inch (13 mm). Correct the ride height if not at specifications.

Specifications

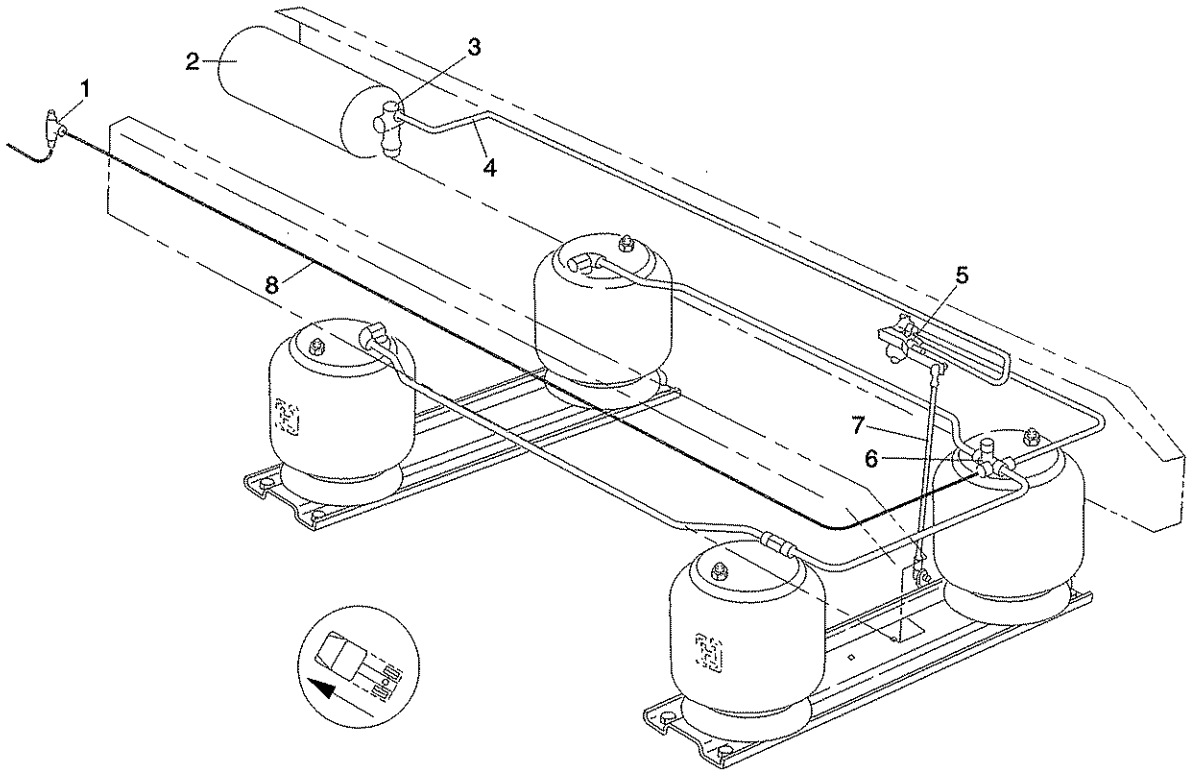
For an overview of the Hendrickson HAS air system plumbing, see **Fig. 1** and **Fig. 2.**

Torque Values		
Description	**Size**	**Torque: lbf·ft (N·m)**
U-bolt High Nuts	7/8–14	Stage 1: Hand tighten Stage 2: 60 (81)* Stage 3: 200 (271)* Stage 4: 420 to 500 (571 to 680)*
	1–14	Stage 1: Hand tighten Stage 2: 60 (81)* Stage 3: 200 (271)* Stage 4: 520 to 600 (707 to 816)*
Torque Rod Bar Pin Locknut	5/8–11	180 (244)
Axle Seat Stud	5/8–11	65 (88)
Rebound Bolt Locknut	1/2–13	60 (81)
Shock Absorber Locknut, Upper	1/2–13	60 (81)
Shock Absorber Locknut, Lower	3/4–10	60 (81)
Cross Channel to Main Support Member Locknut	3/4–10	290 (393)
Air Spring to Frame Hanger Locknut	1/2–13	25 (34)
Air Spring to Cross Channel Locknut	1/2–13	25 (34)
Transverse Rod Locknut	1-1/4–12	200 (271)
Extension Arm Jam Nut	5/16–24	125 (169)
Extension Arm Locknut	5/16–24	125 (169)

* Tighten in a diagonal pattern as shown in **Fig. 3.**

Table 1, Torque Values

Specifications



06/16/99 f320803

NOTE: The height control valve was moved to the forward axle on later HAS systems.

1. Switch Control Valve
2. Air Tank
3. Pressure Protection Valve
4. Air Supply Line
5. Height Control Valve
6. Quick Release Valve
7. Leveling Valve Extension Arm
8. Air Signal Line

Fig. 1, Suspension Air Plumbing

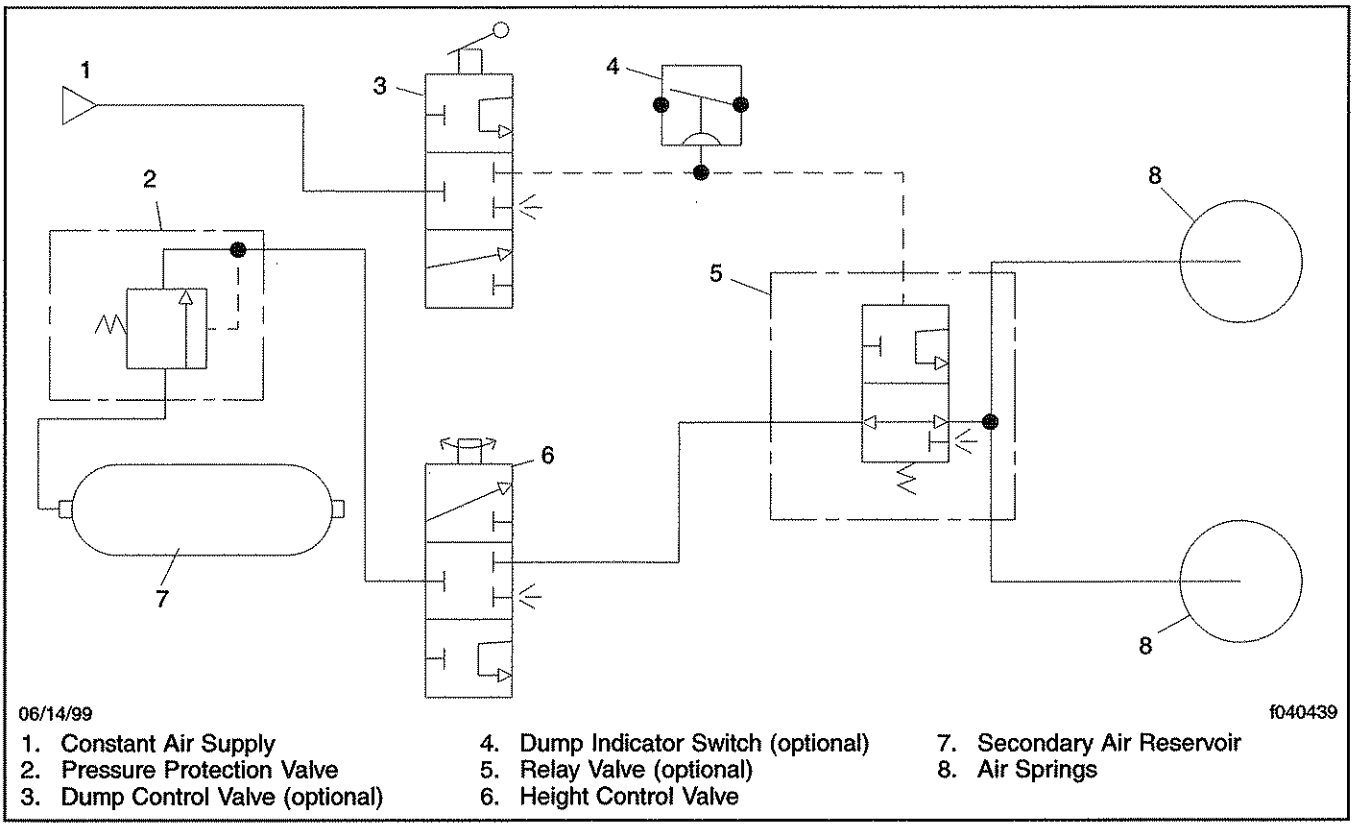


Fig. 2, Air Suspension Dump System Schematic (typical)

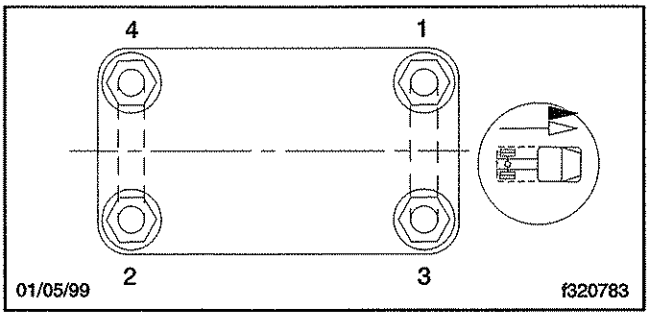


Fig. 3, Tightening Pattern for U-bolt High Nuts

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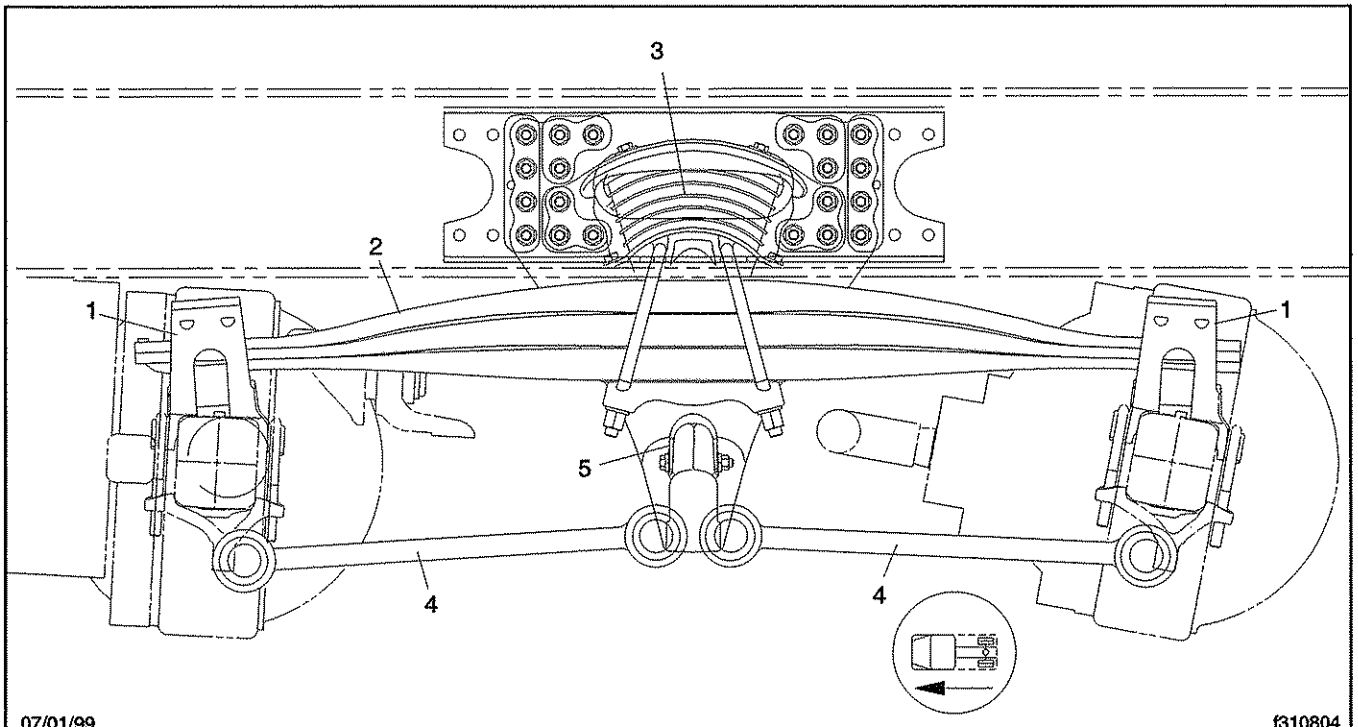
General Description

The TufTrac Suspension (**Fig. 1**) is heavy-duty "six rod" tandem-axle suspension option for trucks built for severe on/off highway work. The TufTrac design allows a truck to maneuver over bumps, ridges and washboard roads that typically generate high rates of axle articulation, without bottoming out the suspension or losing traction.

The TufTrac suspension is available in three weight ratings – 40,000-, 46,000- and 52,000-pound (18 144-, 20 865-, 23 586-kilogram) capacities. The 40,000-pound (18 144-kilogram) capacity suspension uses two taper leaf springs and has an axle spacing of 54 inches. The 46,000-pound (20 865-kilogram) capacity suspension has three leaf springs (shown in this section), while the 52,000-pound (23 586-kilogram) suspension features four leaf springs. Both the 46,000-pound (20 865-kilogram) and the 52,000-pound (23 586-kilogram) suspensions have a standard axle spacing of 56 inches.

Principles of Operation

Six functional links in the TufTrac suspension maintain the positions of the axles. Side-to-side axle movement is controlled by two v-rods from the frame to the axles at the top of the suspension. Four bar links from the frame to the axles at the bottom control the forces of driving and braking as well as fore-and-aft road shocks. Vertical loads are carried by the rubber-isolated parabolic taper leaf spring packs.

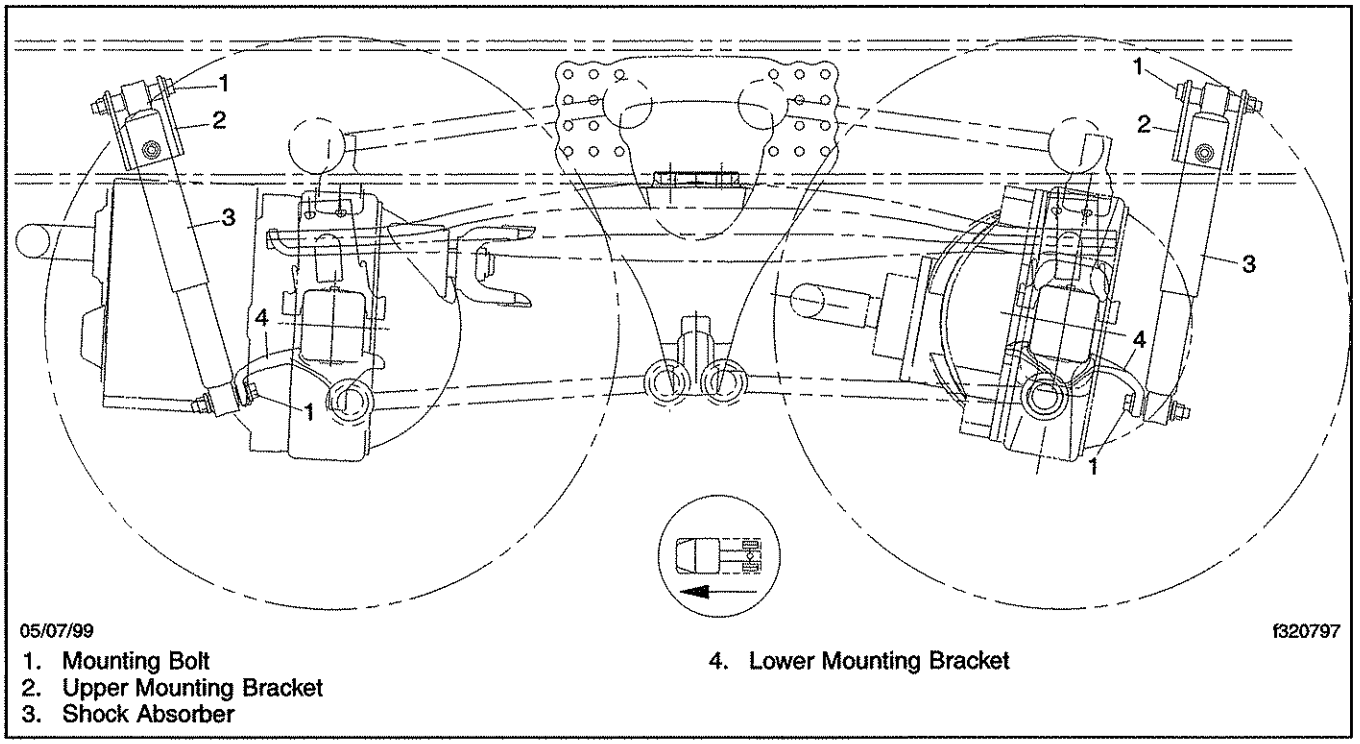


1. Axle Clamps
2. Leaf Springs
3. Center Bearing
4. Lower Control Rods
5. Rebound Stop

Fig. 1, TufTrac Suspension (46,000-pound [20 865-kilogram] version shown)

Replacement (See Fig. 1)

1. Park the vehicle on a level surface, shut down the engine and apply the parking brakes. Chock the tires.
2. Remove the lower shock mounting nut and washer.
3. Remove the upper shock mounting nut and washer.
4. Remove the upper and lower mounting bolts and remove the shock absorber.
5. Position the new shock absorber in place and install the mounting bolts.
6. Loosely fasten the bolts with the nuts and washers removed from the old shock absorber.
7. Torque each mounting nut 241 lbf·ft (327 N·m).
8. Remove the chocks from the tires.



1. Mounting Bolt
2. Upper Mounting Bracket
3. Shock Absorber
4. Lower Mounting Bracket

Fig. 1, Shock Absorber Replacement

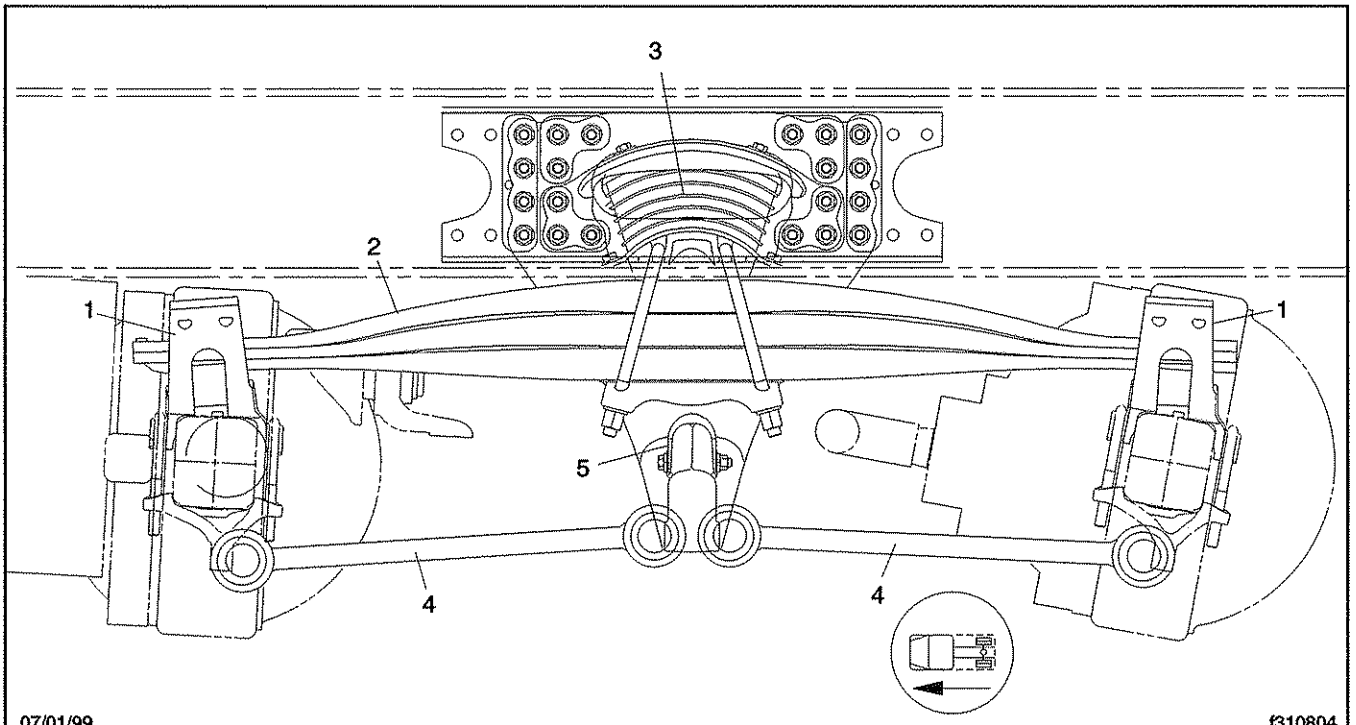
Center Bearing Replacement

Replacement

1. Park the vehicle on a level surface, shut down the engine and apply the parking brakes. Chock the tires.
2. Remove the rebound stop from the suspension. See **Fig. 1**.
   - 2.1 Remove the nut and bolt securing the rebound stop to the mounting bracket.
   - 2.2 Slide the rebound stop from the mounting bracket.
3. Remove the upper two fasteners on the center bearing.
4. Jack up the vehicle under the rear axle.
5. Support the rear frame rails with jack stands, then lower the jack. This will clear the center bearing from the top of the mounting bracket. See **Fig. 2**.
6. Remove the lower center bearing bolts attached to the spring assembly casting. Discard the bolts.
7. Remove the center bearing. See **Fig. 3**.
8. Position the new center bearing in the mounting bracket.
9. Install the upper mounting bolts and tighten 68 lbf·ft (92 N·m).
10. With the jack, raise the rear axle until bottom of the center bearing meets the mounting bracket on the leaf springs.

IMPORTANT: Be sure to use new bolts with loctite (p/n 23–12576–125) when attaching the center bearing to the leaf spring casting.

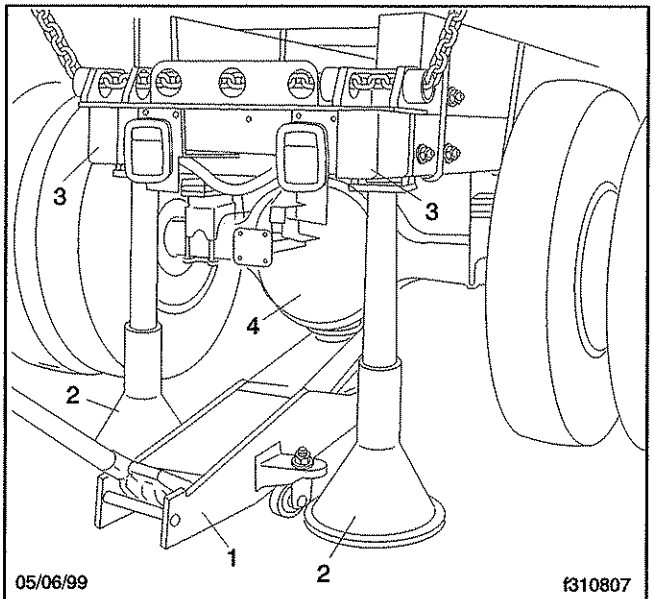
11. Install new lower mounting bracket bolts (p/n 23–12576–125). Tighten the bolts 155 lbf·ft (210 N·m).
12. Return the vehicle to its normal operating position.
13. Install the rebound stop.



1. Axle Clamps
2. Leaf Springs
3. Center Bearing
4. Lower Control Rods
5. Rebound Stop

Fig. 1, TufTrac Suspension (46,000-pound [20 865-kilogram] version shown)

Center Bearing Replacement



1. Jack
2. Jack Stand
3. Frame Rail
4. Rear Axle

Fig. 2, Jack and Jack Stand Placement

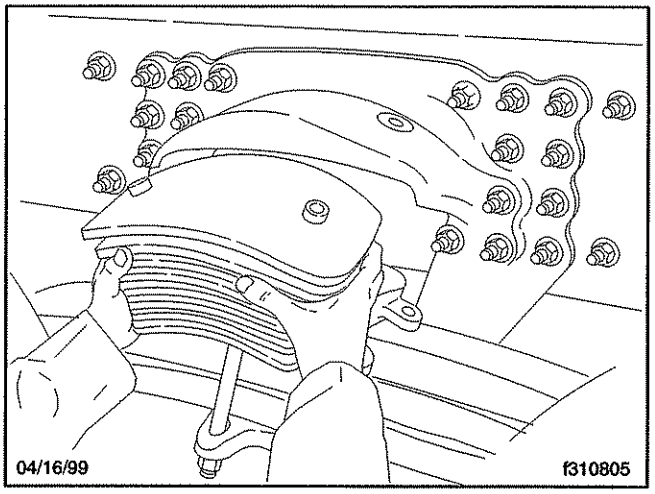


Fig. 3, Center Bearing Removal

14. Remove the chocks from the tires.

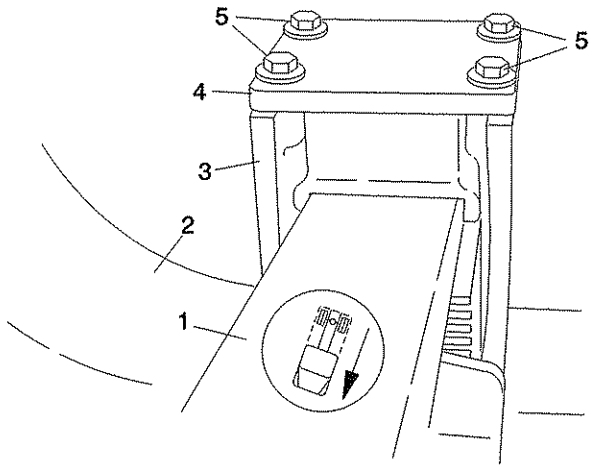
Replacement

1. Park the vehicle on a level surface, shut down the engine and apply the parking brakes. Chock the tires.
2. Remove the tip pad bolts above each axle on the axle clamp. There are four bolts on each pad. See **Fig. 1**.
3. Remove the center bearing. See **Subject 110**.
4. With the vehicle still raised, remove the wheels on both rear axles on the side the spring assembly will be replaced. For instructions, see **Group 40**.

⚠ WARNING

Do not attempt to remove the spring assembly by hand. The assembly is very heavy and attempting to remove it could result in bodily injury.

5. Using a lift (i.e. engine hoist), remove the leaf spring assembly from the vehicle. See **Fig. 2**.



1. Leaf Springs
2. Axle
3. Axle Pad
4. Tip Pad
5. Tip Pad Bolts

Fig. 1, Tip Pad Installation

⚠ WARNING

Do not attempt to install the spring assembly by hand. The assembly is very heavy and attempting to remove it could result in bodily injury.

6. Place the new spring assembly on the vehicle.
   - 6.1 Attach the new assembly to the lift.
   - 6.2 Using the lift (hoist), lift the assembly into place on the axle clamps.
7. Install the center bearing. For instructions, see **Subject 110**.
8. Install the tip pad and bolts on each axle clamp. Tighten the bolts 37 lbf·ft (50 N·m). See **Fig. 1**.
9. If not already installed, install the rebound stop and mounting bolt. Tighten the nut 68 lbf·ft (92 N·m).
10. Install the wheels. For instructions, see **Group 40**.
11. Return the vehicle to its normal operating position.
12. Remove the chocks from the tires.

Spring Assembly Replacement

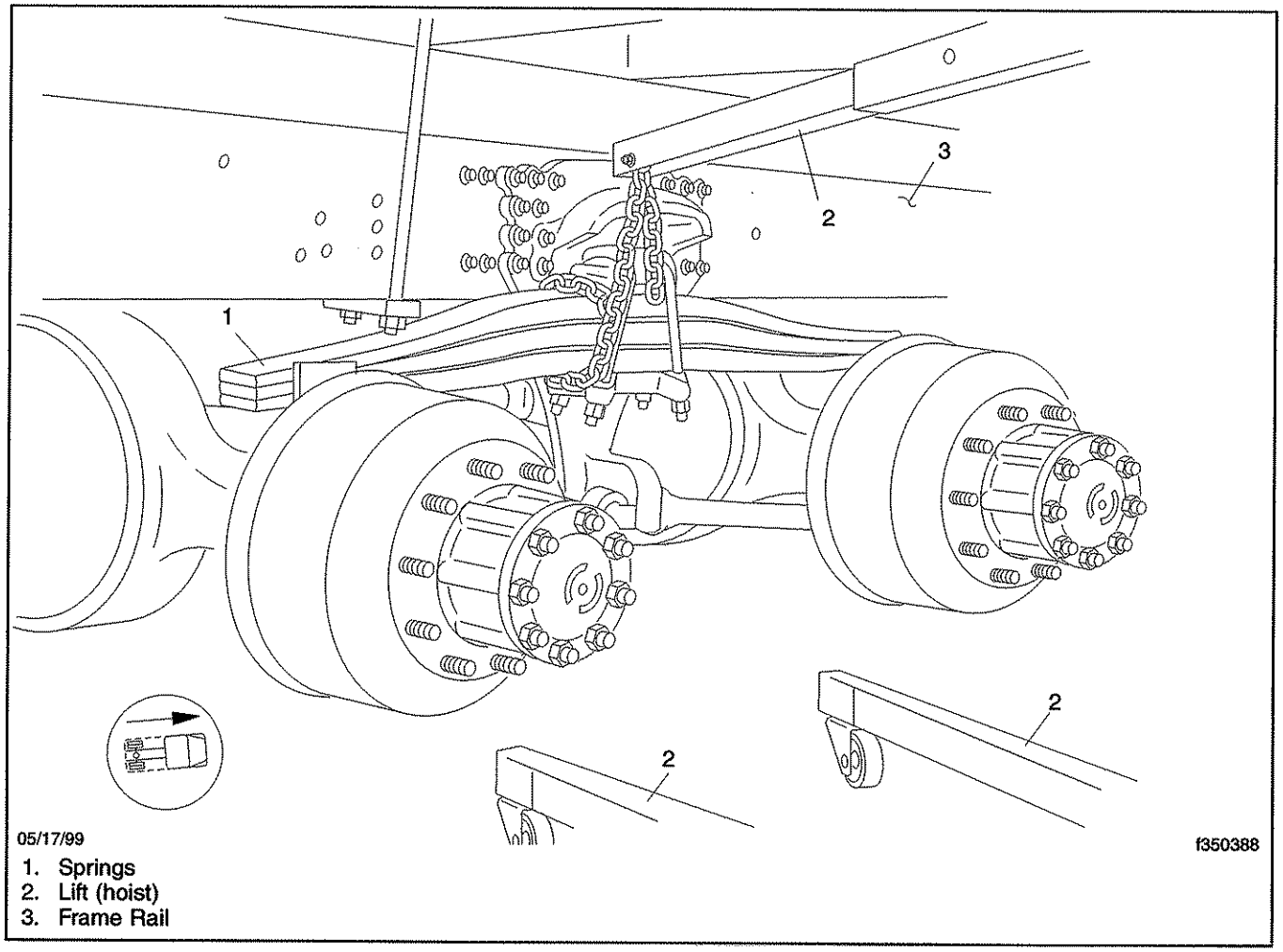


Fig. 2, Leaf Spring Replacement

Lower Control Rod and V-Rod Replacement

Lower Control Rod Replacement

(See Fig. 1)

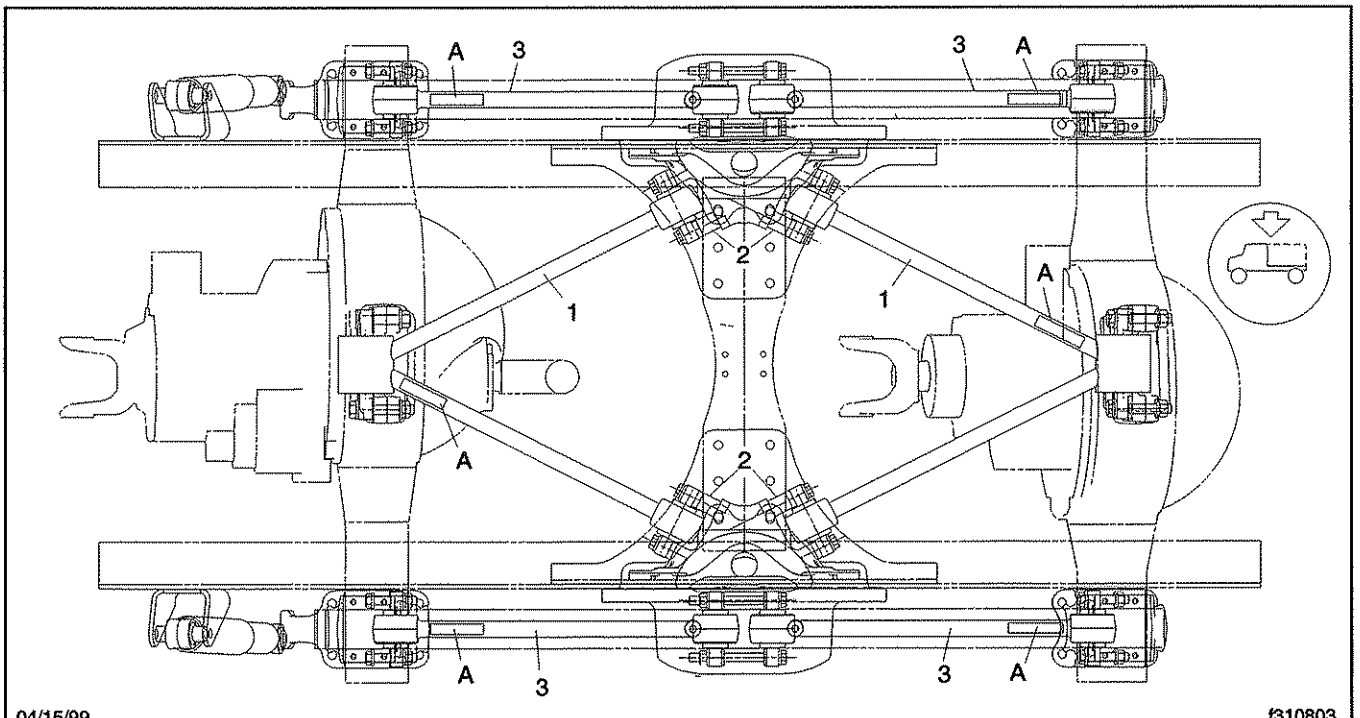
1. Park the vehicle on a level surface, shut down the engine, and apply the parking brakes. Chock the front tires.
2. Raise the rear axle and support the frame rails with jack stands.
3. Lower the jack under the axle. See **Fig. 2.**
4. Remove the bolts holding both rods between the rear axles, below the rebound stop. See **Fig. 3.**
5. Remove the nut and bolt from the axle clamp.
6. Remove the control rod from the vehicle.

IMPORTANT: When installing the rods make sure the labels on the rods are facing upward. Forward axle rods are marked "FDA" and rear axle rods "RDA."

7. Fasten the new control rod to the axle clamp. Tighten the nut 136 lbf·ft (184 N·m).
8. Fasten the other end of the rod to the bracket below the rebound stop. Tighten the nut 136 lbf·ft (184 N·m).
9. Return the vehicle to the normal operating position.

V-Rod Replacement

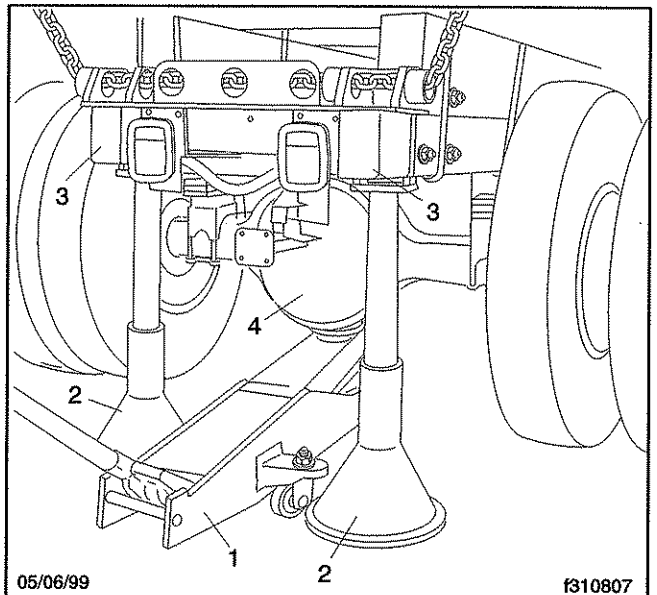
1. Park the vehicle on a level surface, shut down the engine, and apply the parking brakes. Chock the tires.
2. Raise the rear axle and support the frame rails with jack stands.
3. Lower the jack under the axle. See **Fig. 2.**
4. Remove all six mounting bolts securing the v-rod to the chassis and axle.



A. Label
1. V-Rod
2. Spacer
3. Lower Control Rod

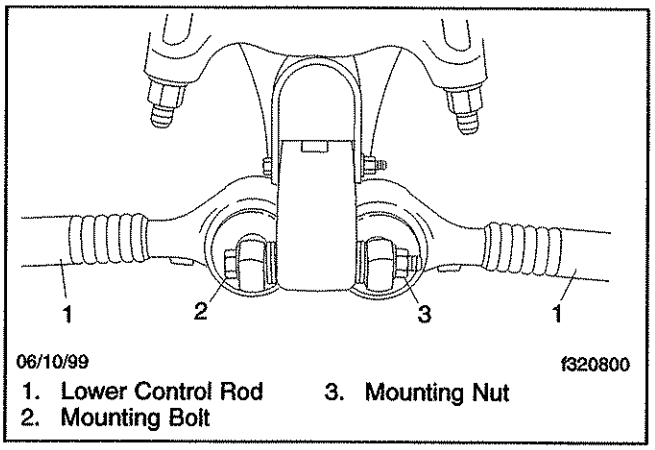
Fig. 1, Control and V-Rod Replacement

Lower Control Rod and V-Rod Replacement



1. Jack
2. Jack Stand
3. Frame Rail
4. Rear Axle

Fig. 2, Jack and Jack Stand Placement



1. Lower Control Rod
2. Mounting Bolt
3. Mounting Nut

Fig. 3, Lower Control Rods

5. Remove the v-rod from the chassis.

IMPORTANT: When installing the rods make sure the labels on the rods are facing upward. Forward axle rods are marked "FDA" and rear axle "RDA."

6. Install the v-rod. See **Fig. 4**.

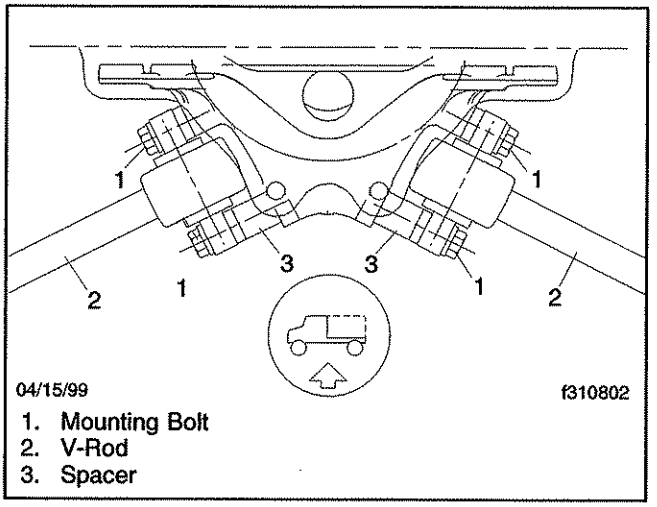
   6.1 Place the new rod in position between the frame rails.

   6.2 Install the bolts and spacers and loosely tighten all connections.

   6.3 After all fasteners and spacers are installed, torque as follows:

   - Tighten the bolts at the frame bracket 136 lbf·ft (184 N·m).
   - Tighten the bolts at the axle bracket 427 lbf·ft (579 N·m).

7. Return the vehicle to normal operating position.
8. Remove the chocks from the tires.



1. Mounting Bolt
2. V-Rod
3. Spacer

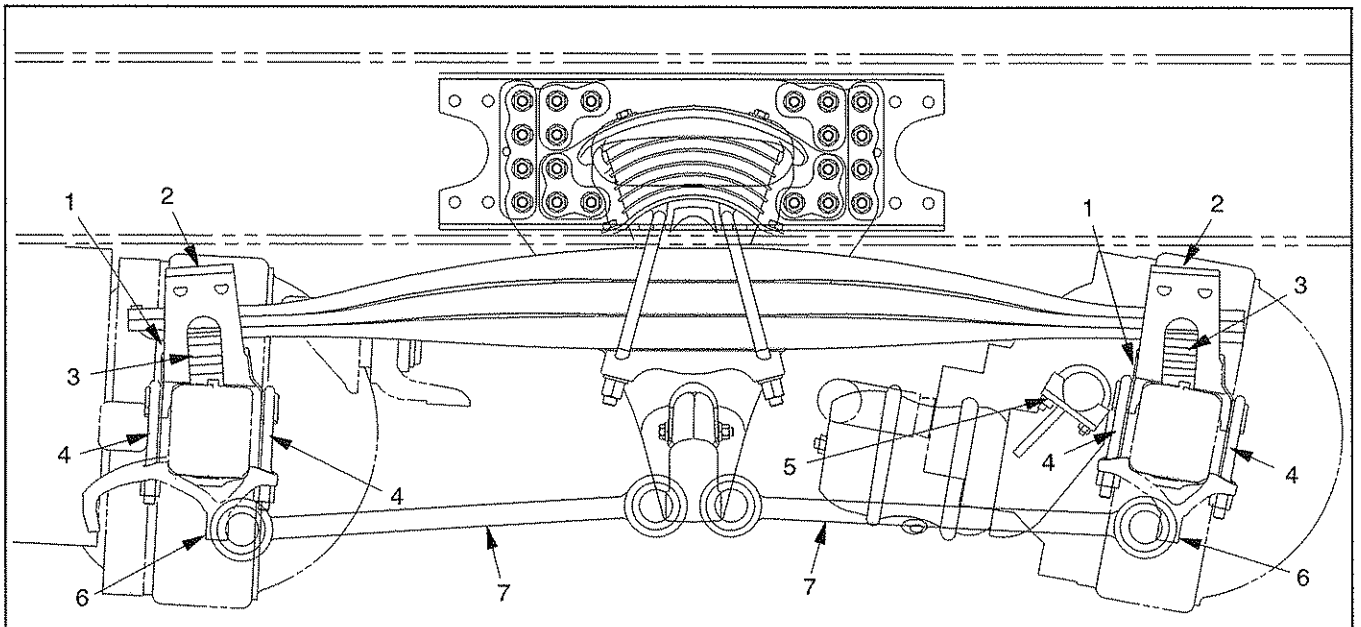
Fig. 4, V-Rod Replacement

Axle Clamp and Retainer Replacement

Replacement

For a side view of the TufTrac suspension, see **Fig. 1**.

1. Park the vehicle on a level surface, shut down the engine and apply the parking brakes. Chock the front tires.
2. Remove the two upper spring tip pads and bolts from the left suspension spring.
3. Disconnect the shock absorbers from the lower axle retainer on the left suspension spring.
   - 3.1 Remove the lower shock mounting nuts and washers.
   - 3.2 Remove the lower shock absorber mounting bolts.
4. Disconnect the two lower torque control rods from the lower axle retainers on the left side of the vehicle.
5. Loosen and remove the U-bolt nuts and washers, and discard.
6. Remove the brake cam tube support bracket from the left rear axle.
7. Remove the lower axle retainers from the left forward and left rear drive axles, and discard.
8. Remove the axle U-bolts from the left forward drive axle and the left rear drive axle, and discard.
9. Jack up the center of the left suspension spring (at the center bearing, between the tandem) and support with the jack stands at the frame. See **Fig. 2**. Make sure that all of the weight has been relieved from the axle clamp group and that there is sufficient clearance to remove the upper axle clamp.
10. Remove the lower spring tip pads from the left forward and left rear drive axles.
11. Remove the upper axle clamps from the left forward and left rear drive axles. Discard the clamps.
12. Install the new upper axle clamps from the applicable warranty kit to the left forward and left rear



1. Upper Axle Clamp
2. Upper Spring Tip Pad
3. Lower Spring Tip Pad
4. U-Bolt
5. Brake Cam Tube Support Bracket
6. Lower Axle Retainer
7. Lower Control Rods

Fig. 1, TufTrac Suspension (left-side view)

Axle Clamp and Retainer Replacement

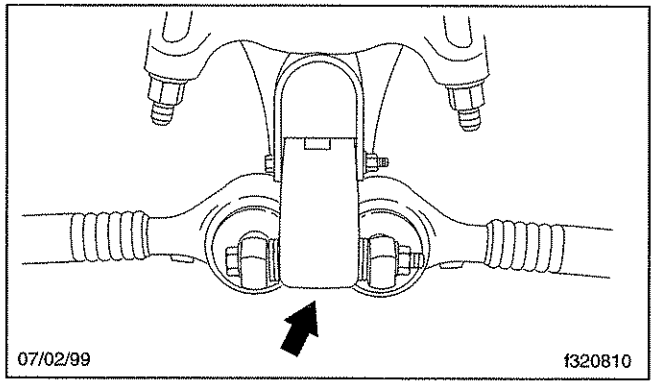


Fig. 2, Jack the Vehicle Here

drive axles. Locate the dowel pin through the hole in the bottom of each axle clamp to confirm proper alignment

NOTE: Confirm that you are installing the correct upper axle clamps before continuing. You are able to visually identify the new upper axle clamp because the step has been removed from the area directly above the U-bolt saddles. See **Fig. 3**.

13. Install the lower spring tip pads into the left front and rear axle clamps.
14. Jack up the left suspension spring, remove the jack stands, and lower the suspension spring. Ensure while the spring is being lowered that it is seated correctly onto the lower spring tip pads.
15. Install the new lower axle retainers onto the left forward and rear drive axles.
16. Install the brake cam tube support bracket onto the left rear axle.
17. Install the U-bolts on the left forward and rear drive axles.

    IMPORTANT: Install two washers for each U-bolt nut.

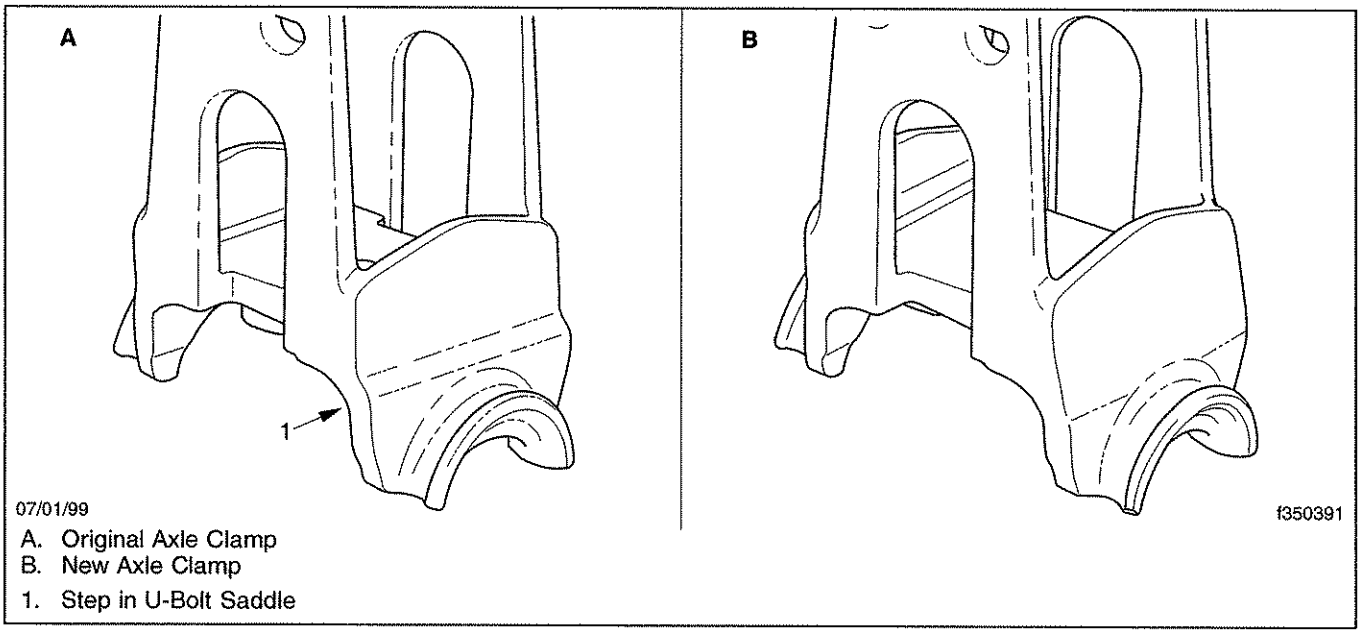
    17.1 Install each U-bolt over the U-bolt saddle in the upper axle clamp and through the holes in the lower axle retainer.

    17.2 Install the washers and finger-tighten the nuts in the order shown in **Fig. 4**.

    Make sure all brackets are snug against the axle housing before proceeding to the next step.

    IMPORTANT: U-bolt nuts must be tightened in the order shown in **Fig. 4**.

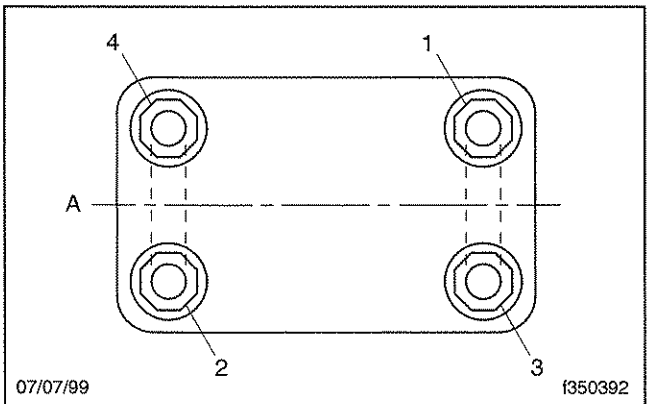
    17.3 Tighten the nuts 60 lbf·ft (81 N·m) and then to 200 lbf·ft (271 N·m) in two separate rotations following the order shown in **Fig. 4**.



A. Original Axle Clamp
B. New Axle Clamp
1. Step in U-Bolt Saddle

Fig. 3, Upper Axle Clamps

18. Install the lower torque control rods to the lower axle retainers on the left side of the vehicle and tighten 136 lbf·ft (184 N·m).
19. Install the shock absorbers to the lower axle retainers.
    - 19.1 Install the lower shock mounting bolts.
    - 19.2 Install the lower shock absorber mounting washers and nuts and tighten by hand.
    - 19.3 Tighten the lower shock absorber mounting nuts to 241 lbf·ft (327 N·m).
20. Install the spring tip pads to the left suspension spring.
    - 20.1 Install the spring tip pads to the upper axle clamps.
    - 20.2 Install the bolts to secure each upper spring tip pad and tighten 37 lbf·ft (50 N·m).
21. Repeat the above steps for the right suspension spring.
22. Remove the chocks from the tires.



A. Centerline of Spring
1. Tighten First
2. Tighten Second
3. Tighten Third
4. Tighten Fourth

Fig. 4, U-Bolt Nut Tightening Sequence

Adjustments

Rear axle positioning and alignment on a vehicle equipped with the TufTrac suspension is determined by the length of the lower control rods and the V-rods. See **Fig. 1**. The length of the control rods and V-rods can be controlled by the addition or removal of shims at the mounting points of the control rods and/or V-rods. The addition of shim(s) between the control rod or V-rod and its mounting will effectively lengthen the rod moving the axle relative to the frame. Conversely, the removal of shim(s) will shorten the length of the rod, moving the axle in the opposite direction.

The lower control rods use a horse-shoe style of shim (**Fig. 2**) while the V-rods use hardened washers for shims.

Control rod shimming is performed at the center bracket. See **Fig. 3**. The purpose of this shim adjustment is to provide axle alignment and planing adjustment (angle of the axle from vertical in the side view).

Axle tracking (lateral axle positioning) is performed by inserting or removing hardened washers at the V-rod mounting at the frame end. See **Fig. 4**.

Lower Control Rods

Alignment Adjustments

NOTE: Alignment refers to the squareness of the axles to each other and the frame rails viewed from the top of the vehicle.

Add or remove shims at the center bracket to achieve proper alignment. See **Fig. 3**. To minimize the effect on planing angles, if possible, add or remove shims from both sides of the vehicle.

When one 3mm thick shim is added and one removed (from the opposite side) the axle position is affected as follows:

- Angle of the axle in the plan view: 0.33 degrees

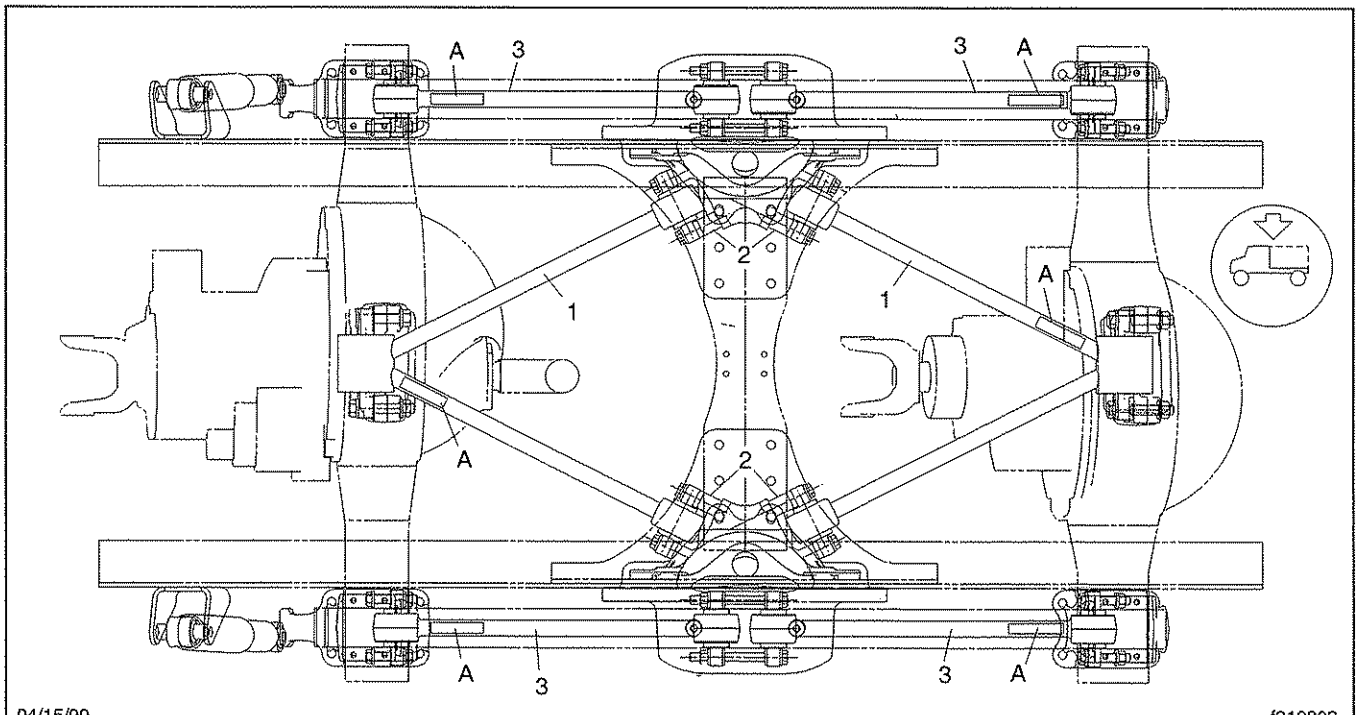


Fig. 1, Control Rod and V-Rod Installation

Rear Axle Alignment Adjustments

- Fore-aft movement of the wheel at the outside (assuming 97.6 in. (2480 mm) wheel to wheel distance): 0.283 in. (7.2 mm)

Planing Adjustments

NOTE: planing refers to the angle of the axle from vertical in the side view.

Add or remove shims at the center bracket to change the planing angle. See **Fig. 3**. Unless alignment is required, an equal number of shims should be used left and right for a given axle; example, when adding one shim to the left forward rod add one shim to right forward rod. A shim 0.12 inch thick changes the planing angle 0.3 degrees.

V-Rods

Axle Tracking Adjustments

The tracking adjustment of the forward and rear axles is done by adding and/or removing hardened washers between the V-rod bar pin and the frame-mounted bracket. See **Fig. 4**.

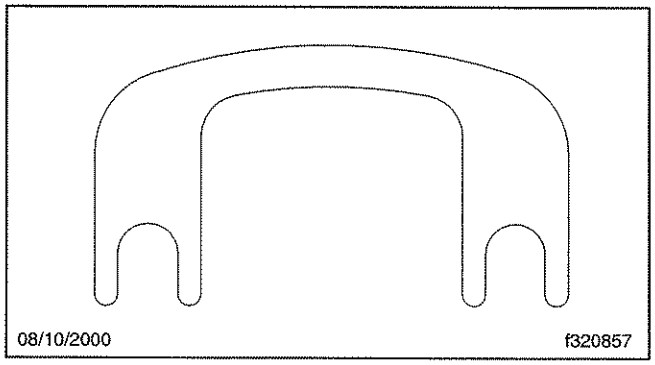
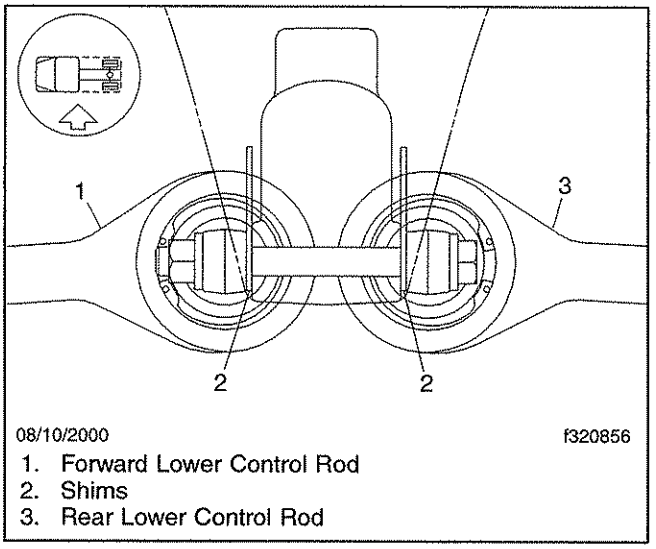
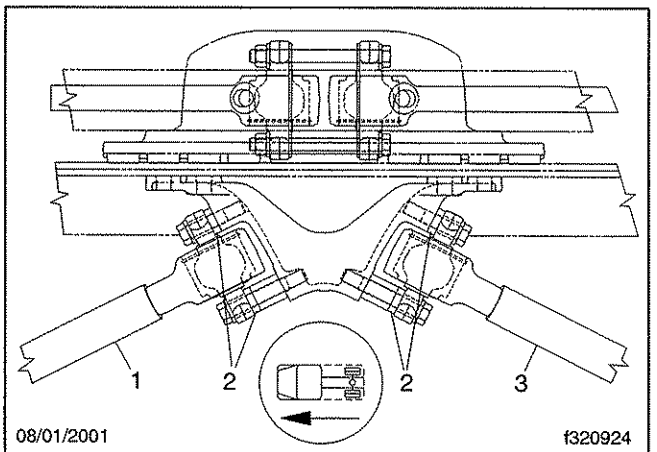


Fig. 2, Lower Control Rod Shim



1. Forward Lower Control Rod
2. Shims
3. Rear Lower Control Rod

Fig. 3, Lower Control Rod Shim Installation

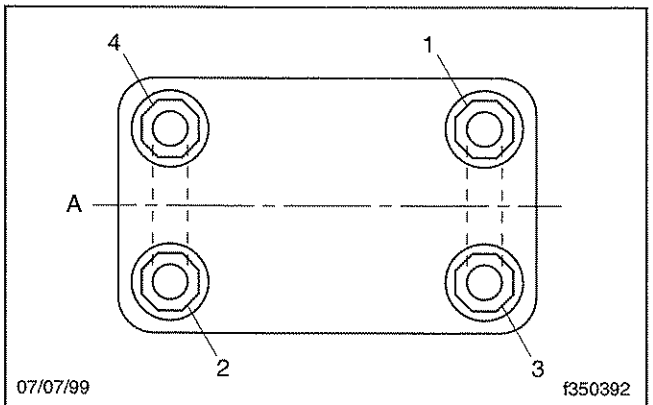


1. Forward Rear Axle V-Rod
2. Hardened Washers
3. Rear Rear Axle V-Rod

Fig. 4, V-Rod Hardened Washer Installation

Torque Specifications	
Description	**Torque: lbf·ft (N·m)**
Shock Absorber Mounting Bolt	241 (327)
Center Bearing Upper Mounting Bolts	68 (92)
Center Bearing Lower Mounting Bolts	155 (210)
Tip Pad Bolts	37 (50)
Rebound Stop Mounting Bolt	68 (92)
Lower Control Rod Mounting Bolts	136 (184)
V-Rod Frame Bracket Mounting Bolts	136 (184)
V-Rod Axle Bracket Mounting Bolts	427 (579)
5/8—18 Axle Clamp U-bolt Nuts (tighten as shown in **Fig. 1**)	Stage 1: Hand-Tighten Stage 2: 60 (81) Stage 3: 200 (271)
3/4-Inch Spring Pack U-bolt Nuts	Stage 1: 60 (81) Stage 2: 200 (271) Stage 3: 300 (406)

Table 1, Torque Specifications



A. Centerline of Spring
1. Tighten First
2. Tighten Second
3. Tighten Third
4. Tighten Fourth

Fig. 1, Tightening Pattern for U-bolt Nuts